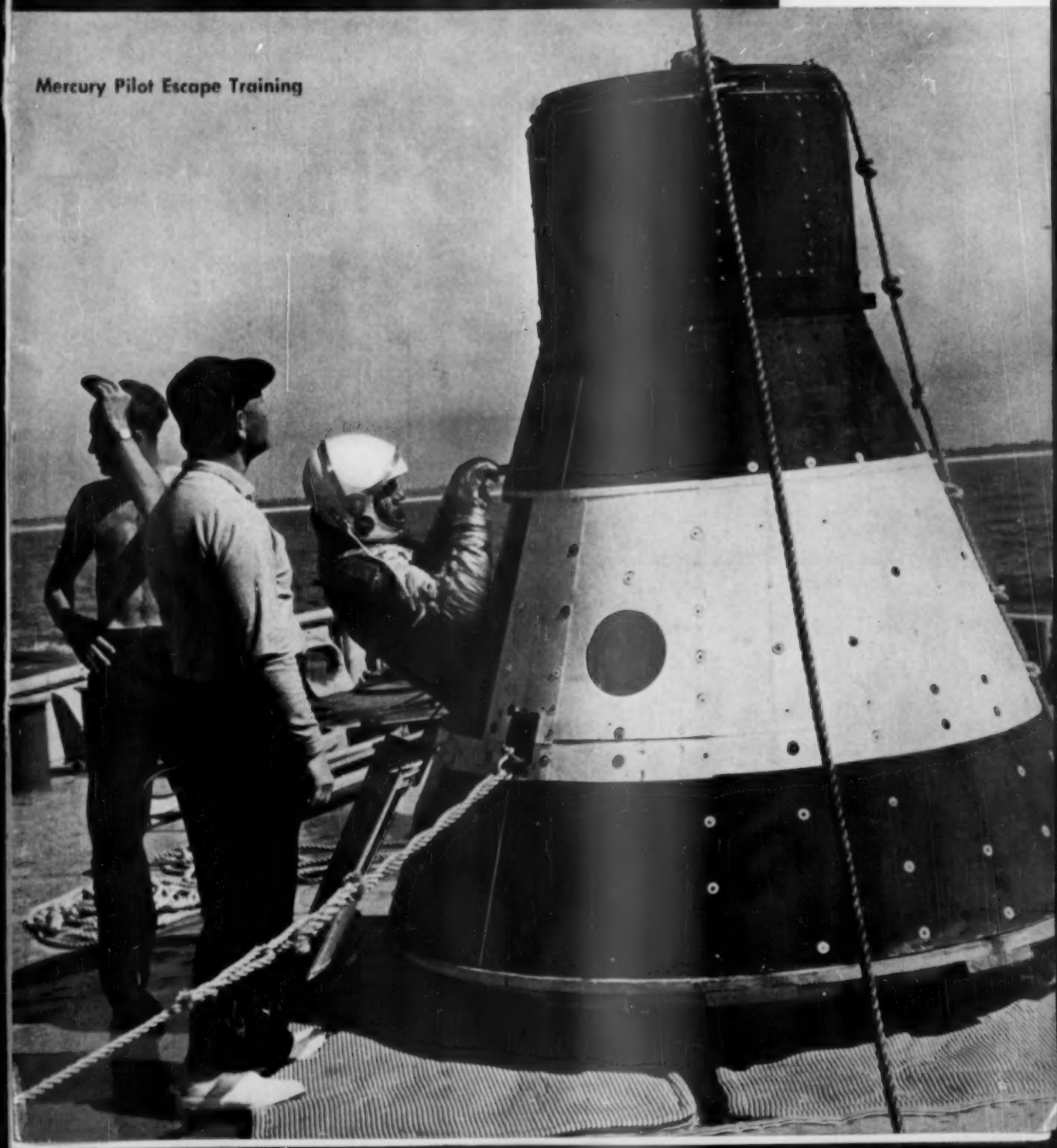
April 25, 1960

Aviation Week and Space Technology

Thiokol Builds Minuteman First Stage

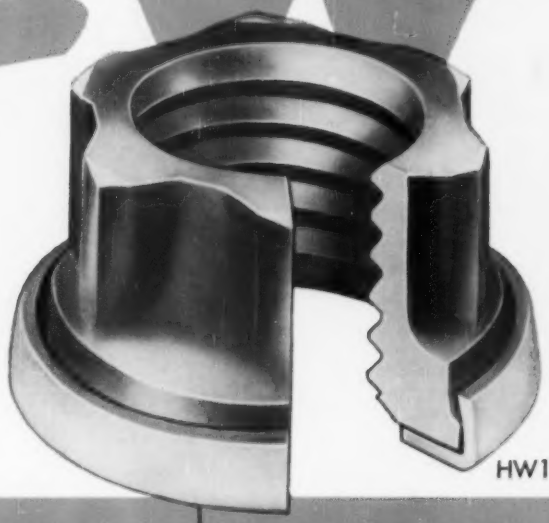


Mercury Pilot Escape Training

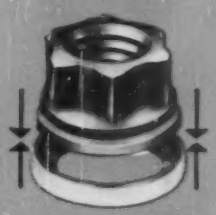
NEW

KAYLOCK® "CAPTIVE WASHER" NUT

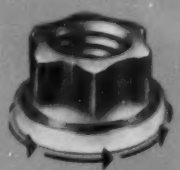
ENDS WASHER WANDERLUST



HW14



Enlarged view of Kaylock H14-3 and washer prior to assembly.



Assembled HW14-3. Integral, free-spinning washer can't drop off. Only one part to buy instead of two.

Complete assembly.

Service Temperature: 800°F. Tensile Strength: 180,000 PSI.

Material: Carbon Steel. Also in A286 for 900°F. applications.

Costly time is wasted on washers with wanderlust. Small, slippery, they roll away, drop off, slide into the hardest-to-get-at places. Now, Kaynar has solved the problem with the new Kaylock HW14 "Captive Washer" Nut, an H14 lightweight, all-metal, self-locking nut with integral, free-spinning, metal washer. Stabilizes frictional characteristics between nut base and aircraft structure. Result: controlled joint tightness.

Saves Assembly Time. Kaylock HW14's cut extra motion required to put washer on bolt. Washer can't drop off during application or removal. Cuts time lost looking for wayward washers . . . *to zero.*

Safer too. There is no chance of equipment jamming or becoming destroyed because of nuts and washers vibrating loose. Kaylock HW14 nuts employ the same, sure elliptical locking principle to prevent vibration hazards. The Kaylock HW14 is a new product development of Kaynar Mfg. Co. Inc., world's oldest and largest manufacturer of lightweight, all-metal, self-locking nuts. For further information, contact your Kaylock representative or write or call Kaynar directly.

Trade Mark

Kaylock® ALL METAL SELF-LOCKING NUTS — *first in lightweight locknuts*

Kaynar Mfg. Co. Inc., Kaylock Division, Box 2001, Terminal Annex, Los Angeles 54, Calif.
Branch offices, warehouses & representatives in Wichita, Kansas; New York, N.Y.; Atlanta, Ga.; Renton, Washington. Canadian Distributor: Abercorn Aero, Ltd., Montreal, Quebec.

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Conversion of analog or PDM data to magnetic tape in the IBM 704 computer format. That's the job done for Martin-Denver, home of Titan ICBM, by an EECo-designed and EECo-built Digital Data Processing System. Can also convert from computer magnetic tape to punched cards.

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EE 0-4

MISSILE AND AIRCRAFT RANGE INSTRUMENTATION • DIGITAL DATA PROCESSING SYSTEMS
COMPUTER LANGUAGE TRANSLATORS • SPECIAL ELECTRONIC EQUIPMENT

AVIATION CALENDAR

(Continued from page 5)

D. C. Sponsors: Institute of Radio Engineers' Professional Group on Component Parts; American Institute of Electrical Engineers; Electronic Industries Assn.; Western Electronic Manufacturers Assn.

May 11-14—16th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 15-18—Annual Convention and Business Meeting, American Assn. of Airport Executives, Waldorf-Astoria, New York.

May 16-20—Aviation Fire Safety Seminar, National Fire Protection Assn., Queen Elizabeth Hotel, Montreal, Canada.

May 18-20—National Meeting, Society for Experimental Stress Analysis, Hotel Severin, Indianapolis, Ind. Theme: Stress Analysis of Propulsion Systems.

May 22-29—Fourth Annual Reserve Navigation Competition, Ellington AFB., Tex.

May 23-25—12th Annual Meeting, German Society for Rocket Engineering and Space Flight Research, Heidelberg, Germany.

May 23-25—1960 National Telemetering Conference, Miramar Hotel, Santa Monica, Calif. Sponsors: Instrument Society of America; American Rocket Society; American Institute of Electrical Engineers; Institute of the Aeronautical Sciences; Institute of Radio Engineers.

May 24-26—1960 Convention, American Society for Quality Control, San Francisco, Calif.

May 25-27—National Specialists Meeting on Guidance of Aerospace Vehicles, Institute of the Aeronautical Sciences, Hotel Somerset, Boston, Mass.

May 26-27—"Psychophysiological Aspects of Space Flight," symposium, Hilton Hotel, San Antonio, Tex. Sponsored by the School of Aviation Medicine, USAF Aero-Space Medical Center (ATC), and arranged by Southwest Research Institute. Unclassified, but by invitation.

June 3-4—11th National Maintenance & Operations Meeting, Reading Aviation Service, Reading, Pa.

June 14-16—35th Meeting, Aviation Distributors and Manufacturers Assn., Queen Elizabeth Hotel, Montreal, Canada.

June 23-25—16th Annual Meeting, Institute of Navigation, U. S. Air Force Academy, Colorado Springs, Colo.

June 27-29—Fourth National Convention on Military Electronics, Institute of Radio Engineers, Sheraton-Park Hotel, Washington, D. C.

June 28-July 1—National Summer Meeting, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif.

Aug. 15-20—11th Annual Congress, International Astronautical Federation, Royal Institute of Technology, Stockholm.

Aug. 23-26—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

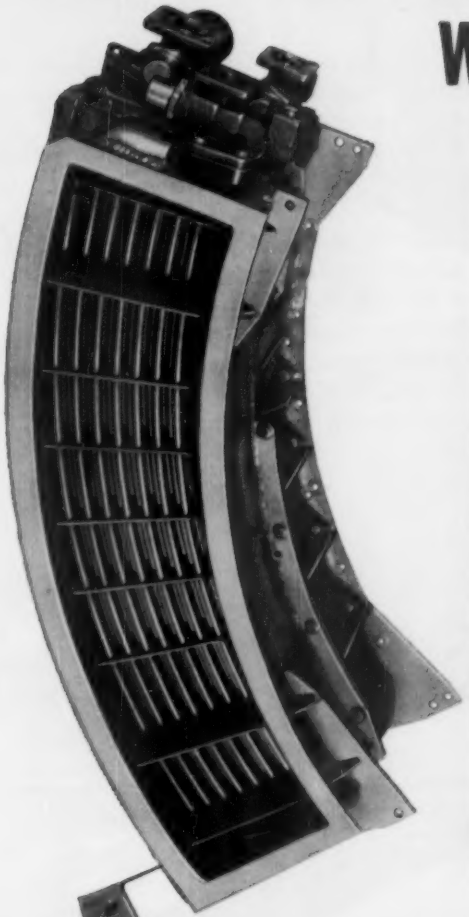
Sept. 5-11—1960 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 12-16—16th Annual General Meeting, IATA, Copenhagen, Denmark.

Sept. 21-25—National Convention and Aerospace Panorama, Air Force Assn., Civic Auditorium and Brooks Hall, San Francisco, Calif.

BOEING'S GOING COOL...

WITH GENERAL MOTORS!



NEW YORK TO PARIS IN JUST OVER 6 HOURS—THE MIGHTY NEW 707 "320" DEPENDS ON HARRISON FOR RELIABLE OIL COOLING!

Meet a great heat leveller! It's Harrison's new oil temperature regulator, engineered expressly to perform three major cooling jobs on the magnificent new Boeing Intercontinental jet airliner. *Cooling the engine oil . . . cooling the oil in the turbo compressor . . . cooling the oil in the constant speed drive*—this is the three-in-one temperature control service that Harrison handles! What's more, this new heat exchanger incorporates, as an integral part of the design, a special protective feature which effectively guards against damage from ice balls and other critical weather hazards. Harrison's long experience and research in the heat-transfer field assure complete reliability . . . peak temperature-control efficiency under the most severe operating conditions. If you have a cooling problem, look to Harrison for the answer.

Harrison Aircraft Oil Coolers—A Quality Product of General Motors Research

GM PRODUCT RELIABILITY . . .
THE KEY TO GREATER VALUE!

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This extensive completion program at AiResearch Aviation Service for Grumman's new prop-jet corporate transport includes: custom business interiors . . . soundproofing . . . radar . . . radio . . . autopilot . . . instrumentation . . . paint . . . maintenance.

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Grumman Gulfstreams undergoing a custom tailored completion program at the AiResearch Aviation Service Company facility.

THE GARRETT CORPORATION

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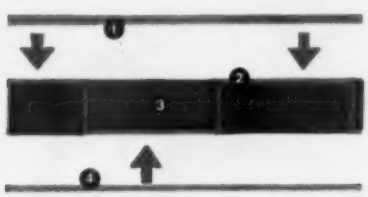
Johns-Manville Announces... MIN-KLAD INTERLOK

. . . a new structural system interlocking Min-K insulation and high-temperature reinforced plastic

Missile experience shows that in certain heat control situations no one material will perform as well as two (or more)—*an insulation with protective high-temperature facings.*

Problem is how to effectively combine these materials into a structurally strong unit? The answer is Min-Klad Interlok



1) Outer facing, 2) Interlocking web, 3) Core, any one of several Min-K formulations, and 4) Inner facing.

All the above components combine to provide a custom-made structural strong insulating system.

—a new structural system that interlocks Min-K insulation and reinforced plastic, metal or other high-temperature facings.

The result: one product that gives the missile designer every advantage of high-temperature plastic or metal foil—strength, toughness, rigidity! Erosion resistance! High heat capacity!

. . . plus the outstanding advantages of Min-K insulation—an insulating core that has the lowest thermal conductivity available for service temperatures up to 2000°F steady-state, and higher for transients. Min-K's thermal conductivity is actually lower than the molecular conductivity of still air.

Wide range of facings

For the hot face, the missile designer can specify Min-Klad Interlok in a wide variety of heat-resistant and/or ablating materials—asbestos-phenolic (ARP-40), and similar reinforced plastics, as well as stainless steel and other heat-resistant metal foils and meshes. For some requirements, the cool face can be made of a different material—for example, one that offers characteristics required for bonding or fastening to other surfaces and parts.

Like all J-M Aviation insulations, Min-Klad Interlok is factory-fabricated to your specifications into external skin panels, heat shields, cylindrical liners or component housings of any shape or size. Write today for technical specifications. Address Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

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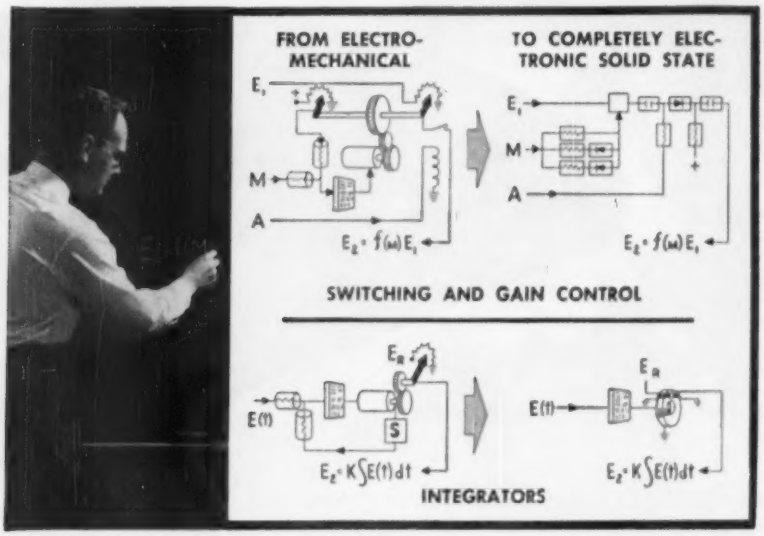
Knowmanship scoring breakthroughs in solid-state electronics



One of the chief assets an associate contractor can offer is his ability to advance "the state of the art." This capability is part and parcel of Eclipse-Pioneer KNOWMANSHIP.

Take automatic flight control systems. In 1954, E-P flew the first successful, fully-transistorized system —forerunner of models now flying or ordered for 34 different airlines of the world, as well as the air forces and navies of the United States and Canada. Currently—on the crest of new E-P breakthroughs in solid-state electronic circuitry—we are developing an automatic flight control system *with no moving parts* between the input sensors and output servos. Effect of eliminating conventional rotating shafts, gear trains, cams, motors, relays, etc., from a typical system will be to *halve* flight control system size, weight, power consumption, and cost. *At the same time, operational reliability will be increased.* The new solid-state systems will be particularly well suited to operation with the new generation of airborne digital computing systems.

If you seek advanced "state of the art" thinking and capability for *your* contracting team, E-P KNOWMANSHIP could well be the answer. To find out, call, wire, or write us today.

69% of E-P's procurement dollars go to small business.

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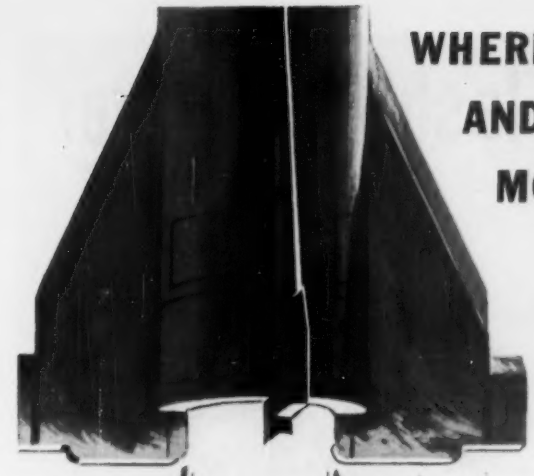

WHERE INCREASED TENSILE, IMPACT AND TEMPERATURES COUNT... MORE ENGINEERS COUNT ON

MIDVAC STEELS

Where maximum reliability and minimum rejects, due to failure to meet mechanical properties, must be attained... more and more engineers are specifying Midvac super alloy steels.

The Midvac process of consumable electrode melting eliminates atmospheric contamination, ingot soundness is improved, segregation is reduced and workability is increased. Ingots and billets produced for missile components, jet engine and aircraft parts and super bearings show increased tensile strength and impact, improved stress rupture at elevated temperatures and longer fatigue life.

The table below shows just a few of the many super alloys being processed by Midvac. Our metallurgical engineers are ready to help you select or specify the Midvac Steel to meet your requirements. Write for complete technical data.

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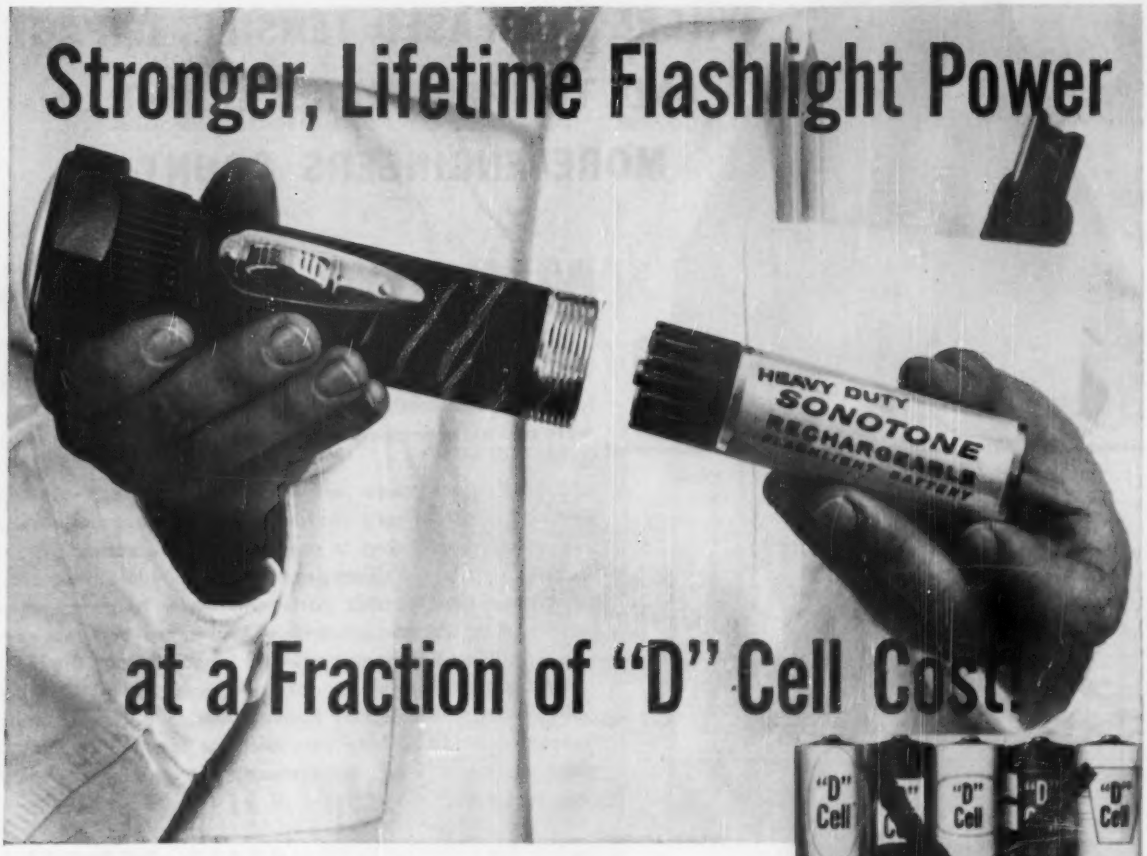
NICETOWN, PHILADELPHIA, PA.
SUBSIDIARY OF HEPPENSTALL COMPANY — PITTSBURGH, PA.
Plants: Pittsburgh, Pa. • Bridgeport, Conn. • New Brighton, Pa.

Alloy	Melting Process	Yield Strength .2	Ultimate Tensile Strength	Percent Elongation	Percent Reduction of Area
A-286	Air Melt	99,000 psi.	132,300 psi.	9.0%	14.7%
	Midvac	117,000 psi.	150,500 psi.	21.3%	33.8%
Gannalloy	Air Melt	112,000	159,900	13.0%	21.0%
	Midvac	142,600	177,250	18.0%	31.6%
D6A-C	Air Melt	234,800	281,000	4.9%	20.6%
	Midvac	256,700	294,250	9.6%	28.4%
Tricent	Air Melt	238,600	284,500	6.1%	19.7%
	Midvac	254,300	291,600	10.3%	25.6%

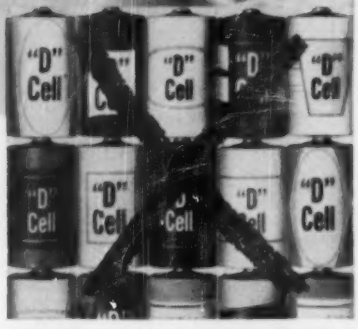
Properties shown are averages of 25 heats

MH *Midvac Steels*

Stronger, Lifetime Flashlight Power



at a Fraction of "D" Cell Cost



Heavy-Duty Sonotone Rechargeable Flashlight Battery Cartridge

To recharge, just unscrew cap...

and plug overnight into any 110-120-volt AC outlet.

- **A multi-use adaptation of the patented Sonotone sintered-plate, nickel-cadmium battery used in space missiles and jets.**
- **Gives at least 3 hours of strong, continuous light from a single charge with PR-6 bulb—or 1½ hours with full-powered PR-2 bulb.**
- **Dependable in extreme temperature and weather conditions.**
- **Can be recharged hundreds of times at about ¼¢ per charge.**
- **Sturdy, leakproof construction—aluminum jacket—electrically shockproof.**
- **Full-year guarantee under heavy industrial use—backed by Sonotone's leadership of over 30 years in precision engineering and service.**

A completely new concept in flashlight battery efficiency and economy for industrial users! Replaces and outmodes any two "D" cells, for any purpose, in end-to-end use. Rechargeable overnight by plugging into any 110-120-volt AC outlet. Gives maintenance and service personnel a battery with a lifetime of use at a fraction of the cost of constantly replaced "D" cells. Dozens of applications—with railroads, aviation lines, municipal departments, public utilities and private industries. **Heavy-Duty Model FC-3** ($9.95 retail)—subject to your usual discounts. Also **Standard Model FC-2** for home use (light lasts at least 1½ hours with PR-6 bulb)—$7.95 retail. Write now for full details to:

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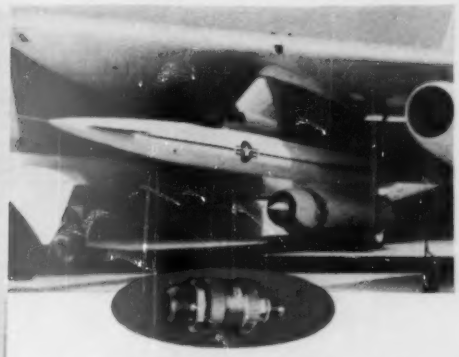
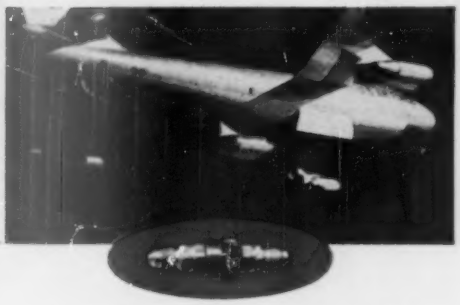
Leading makers of fine transistor hearing aids, ceramic phonograph cartridges, speakers, microphones, electronic tubes, sintered-plate, nickel-cadmium batteries



The Air Force's new Hound Dog missile is equipped with Aeroquip Quick-Disconnect Couplings. Both handling and checkout of the hydraulic systems are facilitated through the use of this coupling on the missile's internal system and ground service checkout equipment.



Space and weight are at a premium on the Quail. To save space, yet retain complete reliability, Aeroquip 1010 Series Quick-Disconnect Couplings are specified. These Self-Sealing Couplings are used in the fuel, lube oil and pneumatic systems of the compact Quail.

Unlimited Coupling Designs for Unlimited Missile Applications

The rapid advance of U.S. missile technology sets continually new requirements for the development of fluid system quick-disconnect couplings. With the largest and most experienced engineering staff in the industry, Aeroquip has designed and manufactured special purpose couplings for many leading missile system contractors. Aeroquip can solve your coupling problems, too. Aeroquip can design and produce a quick disconnect coupling to fit unusual or complicated applications with minimum lead time.

Couplings also are available now in many standardized designs and sizes. In many cases this wide selection means quick delivery of a coupling that meets your requirements. For complete information and assistance mail the coupon below.

The Navy's new supersonic missile, the Corvus, is rocket powered. This swift air-to-ground weapon is equipped with a special Aeroquip Quick-Disconnect Coupling used as an umbilical disconnect. This coupling was especially designed for the Corvus by Aeroquip.

Aeroquip

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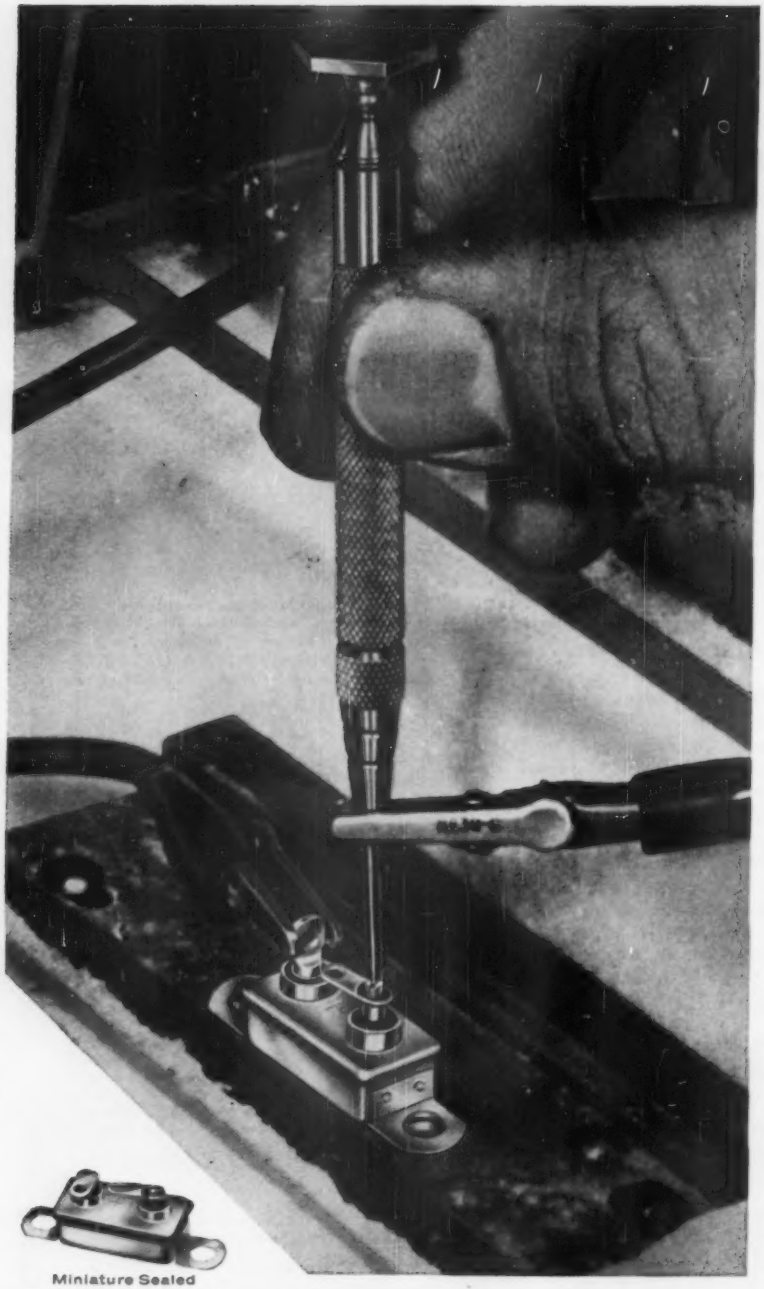

Miniature Sealed
THERMOSWITCH Unit
(actual size)

The Fenwal Miniature Sealed THERMOSWITCH® Unit

Here's the tiny temperature controller that's successfully handling some of today's toughest temperature control problems . . . in missiles and rockets as well as on production machines. Photo shows one of many quality control tests to insure product performance. *It's built to take a beating!*

Hermetically sealed, its rugged design permits normal control action even under the most severe conditions of shock and vibration. Stainless steel case is the heat-sensitive element . . . responds with instantaneous, positive action to heat changes of a fraction of a degree. Unit controls to extremely close limits. *Weighs less than ½ oz.!*

Easily set for *control* of temperatures from −20 to +200°F. When used as *high limit* switch, range is −20 to +275°F. Can withstand continuous exposure from −65 to +325°F. The Fenwal Miniature Sealed THERMOSWITCH Unit is widely used for crystal ovens, tuning forks, gyro assemblies, missile blankets, and missile batteries. Current rating: 2.5 amps, 115 VAC, 2.0 amps, 28 VDC. Find out how this advanced controller can protect the reliability of your product. Write Fenwal Incorporated, 124 Pleasant Street, Ashland, Mass.

Another example of how **Fenwal** CONTROLS TEMPERATURE . . . PRECISELY

REINFORCED PLASTICS FOR STRUCTURES OFFER MAXIMUM RELIABILITY

Helping to make missiles and aircraft stronger is Brunswick's job. Using fibre glass reinforced plastics, we fabricate radomes, fin-tips and other primary structures. They will undergo continuous usage at 550°F., and will withstand much higher temperatures during shorter exposures. We make possible the successful "marriage" of antennae, electrical and structural properties. In addition, Brunswick plastics also provide thermal insulation for these components. If you are considering the use of steel or aluminum, we suggest that you look into the advantages of conventional and filament-wound fibre glass reinforced plastics. Brunswick techniques allow the design engineer to tailor his product to carry the specific load requirement of primary structures. You are assured of superior strength: Brunswick's exclusive Strickland "B" Process winds fibre glass filament to a strength-density ratio of 2,000,000 (the SD ratio of high strength steels is 800,000). Hoop tensile values average 200,000 psi, and composite wall strength ranges from 120,000 to 140,000 psi. Our experience can serve you well. Write or call: The Brunswick-Balke-Collender Company, Defense Products Division Sales Manager, 1700 Messler St., Muskegon, Michigan.

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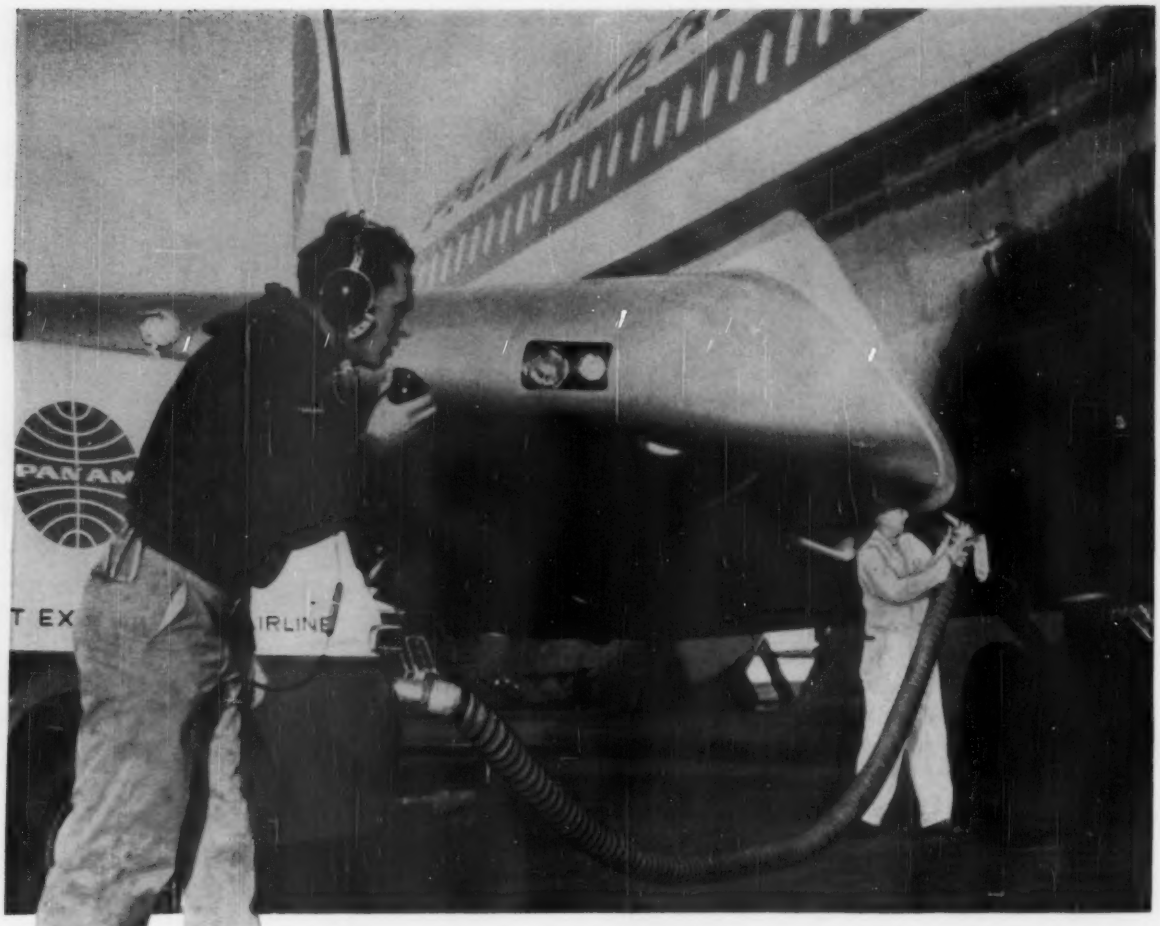
MAKES YOUR IDEAS *WORK*



"Our previous hose gave out after only 1200 to 1400 starts . . .

Thermoid-Quaker Jet-Starter Hose good as new after 3,500 starts"

says Mr. B. V. Darress, Maint. Supr. Pan American World Airways.

Jet-starter hose has to take unusual abuse: transmit hot air up to 500°F at up to 600 MPH under sub-zero conditions . . . withstand dragging over abrasive surfaces. Yet it must be light-weight and flexible . . . easy to handle and coil on the starter truck for storage—and it can't kink, collapse or burst.

Thermoid-Quaker Jet-Starter Hose meets these "impossible" specifications and has proved it can take this kind of abuse with Pan American World Airways and the U. S. Air Force. According to Mr. B. V. Darress of PanAm, their previous hose became unserviceable after only 1200 to 1400 starts. Thermoid-Quaker hose has already outlasted the former hose by *three* to *one* and still looks like new!

Economical service like this is extremely important to both commercial and military jet operations. In fact, this Thermoid-Quaker "Dacron" and Silicone rubber jet-starter hose was developed for military use, and is used by the government. "Dacron" cross-braid construction distributes the load evenly, prevents kinking; and the seamless silicone rubber tube and bonding layer resist heat and provide flexibility under low temperatures.

Get complete information, including Technical Data, on Thermoid-Quaker Jet-Starter Hose from your Thermoid Division industrial distributor, or write *Thermoid Division, H. K. Porter Company, Inc., 200 Whitehead Road, Trenton 6, New Jersey.*

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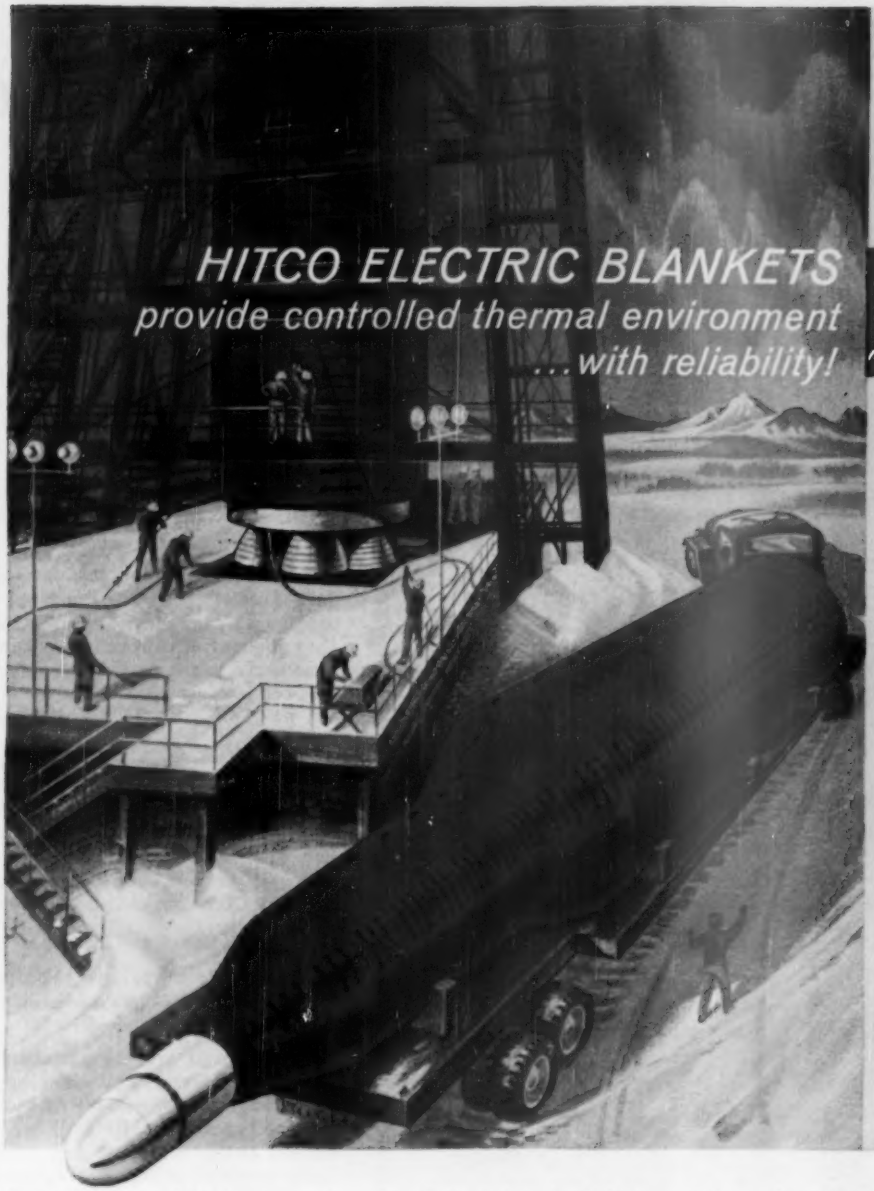

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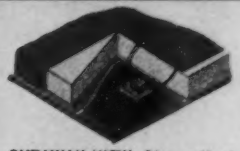
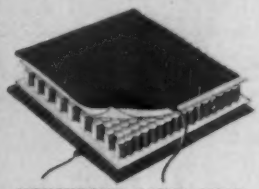
+2200°F



CUTAWAY VIEW. Shows Heating Element of HITCO Electric Blanket—sealed between cover and inner cover.



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April 25, 1960

Aviation Week and Space Technology

Vol. 72, No. 17
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▶Spherical solid propellant retrograde rocket would ease landing of NASA instrument on moon.

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▶Durfee letter asks grounding of Lockheed transport, widens breach between agencies, sparks Senate debate.

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▶Several successful static firings of rocket have been made, program soon will move from R&D into production phase.

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COVER: Project Mercury pilot USAF Capt. Donald K. Slayton slides into side hatch of a boilerplate version of the orbital capsule aboard a barge near the Naval Air Station, Pensacola, Fla., to begin training in escape techniques. Crane lowers the capsule into the water, Slayton must then tip the capsule onto its side, push an extra parachute out of the way and escape through the narrow end of the fuselage. All seven of NASA's Mercury crewmen have undergone similar tests. See pictures on pp. 88-89.

PICTURE CREDITS

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Minuteman

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Minuteman, a three-stage solid propellant intercontinental missile, is moving through its early development and test programs on or ahead of the time schedule originally set for it. This advanced ICBM, the fourth in a family of four Air Force ballistic missiles, is designed to be fired automatically from underground silos or mobile launchers. Minuteman will be constantly at "ready" giving America an almost instantaneous retaliatory capability for defense • The Minuteman concept developed early in 1957 when Space Technology Laboratories conducted a study of the characteristics of second-generation missiles to satisfy the requirements of the Air Force Ballistic Missile Division. STL provides over-all systems engineering and technical direction for Minuteman as it has for the Atlas, Titan, and Thor programs. The application of compatible components, systems, and experience developed through the years is bringing Minuteman closer to the threshold of operational capability • Among the industrial organizations developing Minuteman are such major contractors as: Boeing Airplane Company for assembly and test; Thiokol Chemical Corp., Aerojet General Corp., and Hercules Powder Company for engines; Autonetics, a Divisionof North American Aviation for guidance; and Avco Corp. for re-entry vehicle.

To assure continued growth in these and related space programs, STL is already projecting state-of-the-art advances five and ten years ahead. Outstanding scientists and engineers with unusual capabilities in propulsion, electronics, thermodynamics, aerodynamics, structures, astrophysics, computer technology, and other related fields and disciplines are invited to investigate positions at STL. Please send resumes to:

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EDITORIAL

Politics and Safety

Some unsavory politics have again been injected into the airline safety problem. Airline safety is naturally a matter of almost universal public interest. When the unfortunate series of winter accidents marred what has been a steadily improving over-all safety record, it was inevitable that some politicians would see a new opportunity for some personal publicity and some timorous government officials would run for cover and try to pass the buck wherever possible without regard for either facts or responsibility. Both of these phenomena are now confusing the technical investigations into the causes of the two accidents involving Lockheed Electra turboprop-powered transports at Buffalo, Tex., and Tell City, Ind.

Sen. Vance Hartke (D.-Ind.) has given tongue to some ill-informed and intemperate remarks from the Senate floor on the subject of these Electra accidents. It is obvious that Senator Hartke is emotionally upset over the loss of close friends in one of these accidents and also politically aware of the opportunities resulting from the fact that this same accident occurred in his home state. It is also obvious from his statements that he has little fact on which to base them. They are primarily, by his own admission, from the "grapevine."

It is interesting to note that, while Senator Hartke reaches a peak of emotional fervor in describing the grisly scene of the Tell City crash and the tragic trail of widows and orphans it left among his personal acquaintances, he does not generate equal horror against the bloody record on Indiana's highways where about 1,100 people are slaughtered annually. Senator Hartke's justification of this divergent viewpoint toward human suffering is that the airlines are a common carrier whereas highway safety is a private matter. We doubt if the freshman senator from Indiana will find many of his fellow citizens who agree with this fine distinction.

Airline Role

Nevertheless, we suspect that Senator Hartke's viewpoint is more typical of the average American airline ticket buyer than the more reasoned and technically sound statements of Senators Warren Magnuson and Stuart Symington, both of whom have had considerably more experience with air safety problems than the freshman senator from Indiana. Because of this, the airline industry must take a far more positive position than it has yet shown any indication of doing in discussing fully and frankly with its traveling public the continuing problems of air safety. They also must mobilize the great force of public opinion behind the many positive measures required from the government to improve this situation. We agree heartily with Senator Magnuson's proposal that, when all the extensive technical investigation of the Lockheed Electra now under way is completed, a public congressional hearing should be held to fully inform the public on the problems revealed and their proposed solutions.

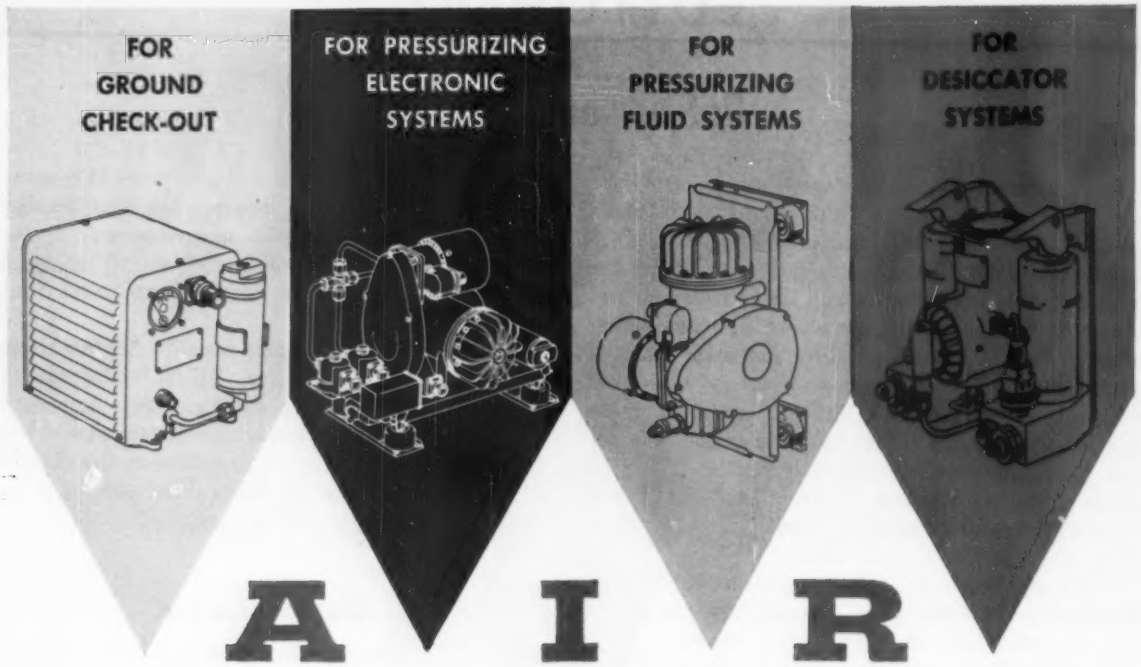
However, there is one point raised by Senator Hartke that bears further investigation. This is the fact that the Federal Aviation Agency and the Civil Aeronautics Board disagreed over whether the Electra should have been grounded. And, it is in exploring this facet of the case that the smell of political irresponsibility and technical ignorance grows strongest.

Durfee Letter

The CAB recommended, in a unanimous action recorded in a letter signed by Chairman James Durfee, that the Electras be grounded pending completion of the inspection currently under way. This action was apparently stimulated by a phone call from a CAB employe at the Central Information Bureau established at Burbank, Calif., that some loose rivets were appearing on a few of the clips joining wing skin and spar. This same evidence was in the hands of the Federal Aviation Agency where it was evaluated as of little technical significance. The rest of the CAB's information on which it based its grounding recommendation was simply scuttlebutt and industry gossip. In the face of an FAA request to produce any factual evidence to support its grounding recommendation, the CAB was unable to do so.

From where we sit this action by the CAB looks like timorous scuttling to evade any subsequent blame for the Electra safety problem and maneuvering into a politically sound but technically sterile position where, regardless of what happens from now on regarding the Electra, the CAB can sit smugly and point the finger of responsibility at the FAA. Fortunately, the transparency of this maneuver is pretty clear to those who have been following the CAB's vindictive rear guard action against FAA's safety activities since President Eisenhower overruled the Board in writing the Federal Aviation Act of 1958.

It is this type of action that will contribute immeasurably to a public lack of confidence in the government agencies concerned with air safety. It is this type of inter-agency sniping that is corroding the foundations of an effective democracy, substituting the goal of political vendetta for effective action toward the common good. It is certainly further evidence for divesting the CAB of all concern with air safety and reducing it to a purely economic regulatory body. —Robert Hotz



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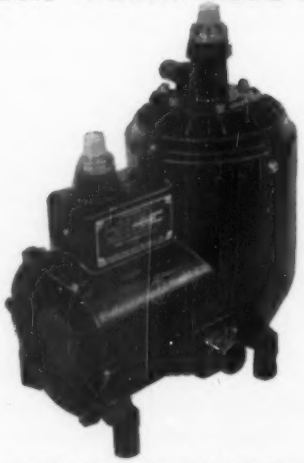

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WHO'S WHERE

In the Front Office

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Robert E. Beach and **Charles H. Chatfield,** vice presidents of United Aircraft Corp., East Hartford, Conn. Mr. Beach continues as corporation counsel. **Grant A. Ring** succeeds Mr. Chatfield as secretary.

Dr. Sidney J. Stein, a vice president, International Resistance Co., Philadelphia, Pa. Dr. Stein continues as director of research and engineering.

Harry K. Collins, executive vice president and general manager, Paraglas Division of Air Logistics, Inc., Pasadena, Calif.

Emo D. Porro, vice president-marketing, and **Dr. Donald J. Gimpel,** vice president-engineering, Arnoux Corp., Los Angeles, Calif., and all company divisions. Also: **Thomas F. Watson,** general sales manager; **William A. Wilkinson,** director of manufacturing.

Wyman-Gordon Co., Worcester, Mass., has named the following as vice presidents: **Joseph R. Carter,** general manager-Eastern Division; **James L. Roach,** director of marketing; **Robert E. Zell,** general manager, Ingalls-Shepard Division (Harvey, Ill.).

Howard S. Gleason, assistant to the president, Southwestern Industrial Electronics Co., a division of Dresser Industries, Inc., Houston, Tex.

Dr. Milo P. Hnilicka, scientific assistant to the vice president and director of research, National Research Corp., Cambridge, Mass.

Chester C. Spurgeon, assistant to the president of the National Aircraft Noise Abatement Council, Washington, D. C.

Landis S. Gephart, director of the newly created Reliability and Systems Analysis Office, National Aeronautics and Space Administration, Washington, D. C.

Honors and Elections

The Tactical Air Command's 4520th aerial demonstration team "The Thunderbirds" has been named 1959 recipient of the **Mackay Trophy** for its successful goodwill tour of the Far East Oct. 21-Dec. 10, 1959. **Capt. Herbert L. Mattox, Jr.,** helicopter pilot assigned to the 33rd air rescue squadron (MATS), has been named 1959 recipient of the **Cheney Award** for his successful pickup of 29 men stranded on a wrecked Japanese fishing trawler.

Edward L. Hays, superintendent of the Safety and Survival Equipment Research and Development Division of the Air Crew Equipment Laboratory of the Naval Air Materiel Center, has been appointed to the National Academy of Sciences as a member of the Academy's Panel on Closed Ecological Systems.

(*Continued on page 127*)

INDUSTRY OBSERVER

► Army hopes to contract for development of a mobile ballistic missile defense system for field use to knock down short-range ballistic missiles if Fiscal 1961 funds permit. Potential list of bidders include Boeing, Convair, Douglas, General Electric, Hughes Aircraft, Raytheon, Sperry Gyroscope and perhaps Western Electric, which could draw upon techniques developed for its Nike Zeus anti-ICBM program.

► **Defense Department plans a side-by-side comparison of three aerial photo-transmission systems sometime next year to determine which one is best suited for tactical environments. The three reconnaissance systems to be compared are a Fairchild Camera & Instrument unit which uses an optical-electrical scanner and is now being evaluated by the Army Signal Corps (AW Feb. 22, p. 69); a Navy-contracted Fairchild-CBS Laboratories system which employs the latter's recently announced photoscan system and a unit using a facsimile-type scanner made by Panfax for the Air Force.**

► Fuji T1F-1 prototype jet trainer, equipped with Nippon Jet Engine Corp.'s J-3 axial flow powerplant, is scheduled to make its initial flight within the near future. Aircraft will be the first jet aircraft to be fully equipped with Japanese-manufactured components.

► **Contracts for a number of major subsystems for the first Dyna-Soar boost glide vehicle have still not been awarded. Major problem: It is impossible to begin the design of these systems until it is decided whether the vehicle will have a semi-ballistic, high-lift, high-drag shape or will have substantial wing area and resemble current high-speed aircraft.**

► Northrop's Nortronics Division, which will develop inertial guidance system for Skybolt air-launched ballistic missile (GAM-87A), has selected General Electric's Light Military Electronics Department to supply the airborne digital guidance computer. Nortronics and GE were rivals in the original Skybolt guidance system competition.

► **Japan's Ground Self Defense Force will send approximately 50 technicians to White Sands Missile Range and Army Ballistic Missile Agency next year for training in use of Nike air defense weapon systems. Initial increment will be followed by an additional 200 trainees, with the over-all training course spreading over a two-year period.**

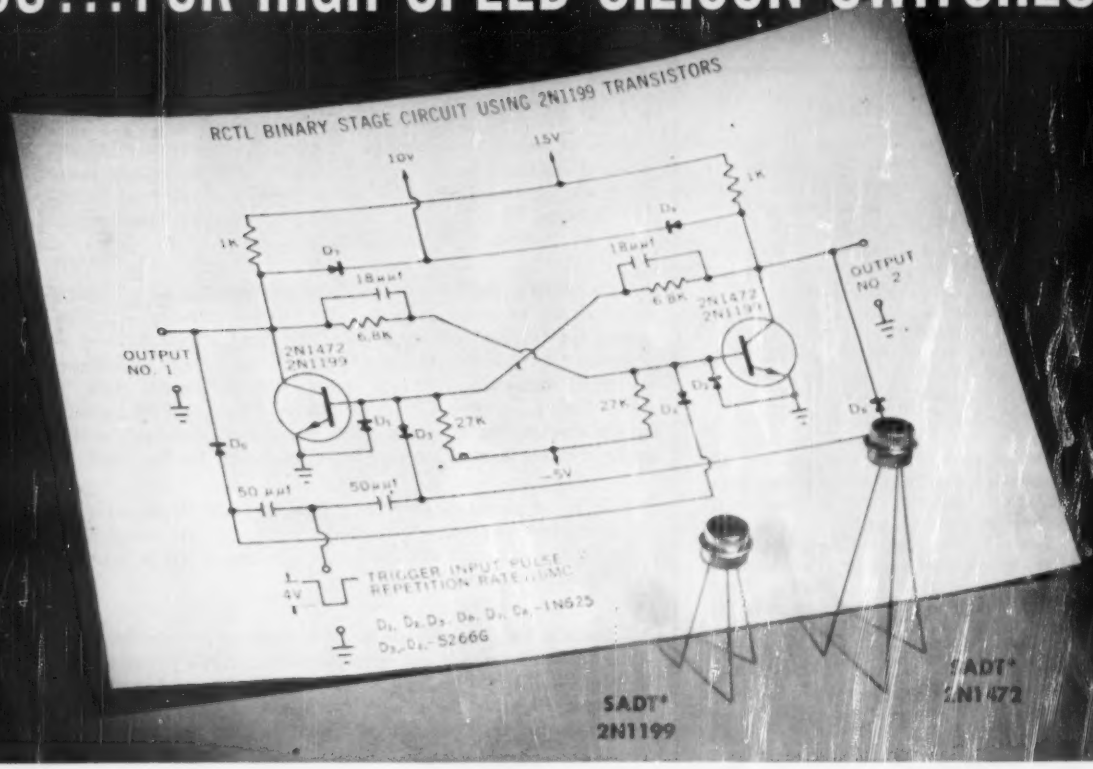
► Reliability of explosive bolts used extensively in separation of multi-staged missiles is proving to be a critical factor in launchings. Bolts have been blamed in a number of test firing failures of both the Polaris fleet ballistic missile and the Titan ICBM.

► **Air Force drive to reduce ballistic missile overhead costs will result in a stretchout in the submission of progress reports and elimination of the usual documentation on film of the performance of nose cones for the Minuteman, Titan and Atlas ICBMs.**

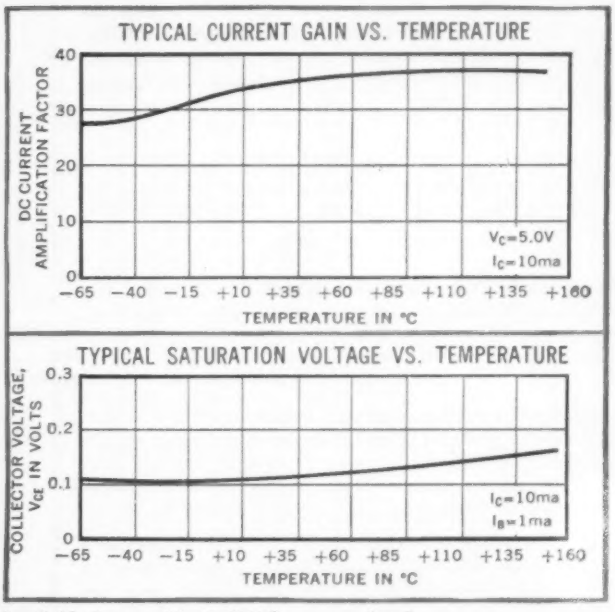
► "Caseless" solid-propellant rocket engines are under study by several developers who hope to find some means of incorporating sufficient stretch in the propellant. One research approach is to use a periphery of slow-burning propellant as the "case."

► **Air Force will begin a gradual reduction of Air Defense Command's Convair F-102 squadrons during the coming year, assigning several units to the Air National Guard. Aircraft remaining in the active USAF inventory will be equipped with a time division data link system to permit greater compatability with the ground environment. Other modifications will be made to improve the F-102's low-altitude kill capability. McDonnell F-101Bs also are scheduled to be modified during the year to receive time data link systems.**

PHILCO...FOR HIGH SPEED SILICON SWITCHES



PHILCO HIGH FREQUENCY NPN SILICON TRANSISTORS OFFER EXCEPTIONALLY LOW SATURATION VOLTAGE



The high frequency response, together with the very low saturation voltage of these silicon Surface Alloy Diffused-base Transistors (typically 0.125 V), permits practical design of 5 mc pulse circuits, using conventional saturated switching configurations. With non-saturating techniques, pulse rates as high as 30 mc are obtainable. The typical switching circuit shown above will operate satisfactorily at trigger pulse rates up to 15 mc. When triggered with a 4-volt pulse at a 10 mc rate, the rise time will be typically less than 24 mμsec over a temperature range of −60°C to +130°C. The typical fall time will be less than 36 mμsec over the same temperature range.

Both of these transistors have demonstrated consistently more stable characteristics over a wide temperature range than any other silicon transistors available. Both meet the environmental and life test requirements of MIL-S-19500B.

NEW, MORE COMPLETE DATA SHEETS

The new data sheets on these transistors, for the first time, provide the designer with complete information upon which he may predict switching speeds in any circuit. They also contain the full military environmental and life test specifications, in accordance with MIL-S-19500B. Copies are available on request. Write Dept. AW-460.

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TRANSISTOR CENTER U.S.A.

Washington Roundup

Dyna-Soar Progress

Air Force apparently is ready to move into phase one of the Dyna-Soar program. Phase Alpha study project is complete. USAF has signed a phase one contract with Boeing for the glider and is signing a phase one booster contract with Martin.

General Accounting Office now expects to deliver its long-awaited report on Air Force missile management to Congress within 30 days. That is the estimate of William A. Newman, new chief of GAO's defense division. Newman was formerly deputy chief under Lawrence J. Powers, who has become assistant to the Comptroller General.

Air Force will decide whether the report should be classified or made public. As GAO prepares its report for Congress, USAF is actively seeking support for its plans to convert Space Technology Laboratories to a nonprofit institution. STL role is a basic point of controversy in missile program management.

Space Reorganization

House Space Committee will meet this week to take action on proposals to abolish the National Space Council and the Civil-Military Liaison Committee. Some changes appear inevitable. President Eisenhower wants to get rid of the space council and the CMLC. William M. Holaday has resigned as chairman of the ineffectual liaison committee effective Apr. 30.

Basic question lies in what kind of organizational structure Congress might establish to replace the two space groups. White House doesn't want any substitutes. But some congressmen feel there should be a strong group managing the space program and an effective means of linking civil and military efforts.

Tougher patent policy on inventions developed under government research contracts will be pushed by the Senate Judiciary Committee. Sen. Joseph O'Mahoney, chairman of the subcommittee on patents, is sponsoring a bill that would tighten patent policy. The committee hopes to begin hearings soon.

The O'Mahoney bill would require close scrutiny of patent implications before an agency such as the Defense Department could turn patent rights over to one of its contractors. Agencies would have to get an opinion from National Science Foundation and the Attorney General before giving title to an invention to a contractor.

Senate move runs counter to a liberalizing trend in patent policy on the House side. House Space Committee supports NASA's request to liberalize its presently rigid patent policies along Defense Department lines.

Senate Judiciary Committee won't be handling the space law patent changes, but the group could promote opposition to them when they reach the Senate.

Soviet Missiles

Magnitude of Soviet missile production was recently revealed by Premier Nikita Khrushchev. Discussing aviation, he said missiles are produced along with aircraft in some dual-purpose Soviet plants. He also indicated missiles are currently in production in several different plants.

GAO and a Senate small business group are trying to cut down sole-source defense procurement. Senate Small Business Procurement Subcommittee headed by Sen. George Smathers joins GAO in pressing Defense Department to require complete manufacturing drawings from companies winning contracts in design competition. Purpose is to introduce competition into follow-on procurement.

GAO is investigating sole-source buying of spares and parts by Air Force. USAF is accused of awarding "open" sole-source contracts which provide for buying an indefinite quantity of spares at a price negotiated when the order is placed.

House Armed Services Committee will hold hearings this week on defense procurement policy, as required in last year's Renegotiation Act extension. Aerospace Industries Assn. favored the investigation, but there is little enthusiasm in Congress for it. Senate Armed Services Committee will hold similar hearings next month.

National Policy Hearing

Senate subcommittee on national policy machinery will hold hearings this week on the relationships between science and technology and foreign and defense policy. Senate group headed by Sen. Henry Jackson is looking for a way to mesh scientific and technical developments with the evolution of policy.

Testifying at these hearings will be: James A. Perkins, Carnegie Corp. vice president and a member of the Gaither Committee; James B. Fisk, president of Bell Telephone Laboratories and vice chairman of the President's Science Advisory Committee; W. H. Pickering, director of NASA's Jet Propulsion Laboratory; Rueben F. Mettler, vice president of Space Technology Laboratories; Herbert York, Defense Department director of research and engineering; Edward Purcell, Harvard University physics professor and a member of the President's Science Advisory Committee, and Eugene Wigner, Princeton University mathematical physics professor. —**Washington Staff**

Ranger Lunar Impact Planned for 1961-62

Spherical solid propellant retrograde rocket would ease landing of NASA instrument capsule on moon.

By Michael Yaffee

Project Ranger lunar impact vehicle is expected to use a high mass ratio, spherical, solid propellant rocket engine as a retrograde rocket to ease landing of the instrument capsule on the moon's surface.

Ranger, part of National Aeronautics and Space Administration's lunar and planetary program, consists of a series of missions that will become active in the 1961-62 period. Atlas Agena-B with mid-course guidance will serve as the launching vehicle. The Ranger program will be carried out for NASA by Jet Propulsion Laboratory.

Primarily, Ranger is designed to take and transmit high resolution photographs of the lunar surface. The vehicle in which the camera is located—this will sit on top of the Agena-B—will not be decelerated and is expected to be destroyed on impact. A second part of the experiment calls for the use of a 300-lb. instrument capsule that can be detached from the main vehicle to make a rough landing on the lunar surface.

As defined by NASA officials, a rough landing is one in which the payload, the capsule and contained instruments, are not destroyed. There will be some velocity control, but landing speeds may run as high as 500 fps. Instrument content of the capsule has still not been decided, but high on the priority list will be a seismometer to record any tremors present.

Aeronutronic Division of Ford Motor Co., Hughes Aircraft and North American Aviation's Missile Division recently completed a six-week study of the capsule and landing technique and have now submitted proposals to JPL. NASA and JPL are currently evaluating the proposals and are expected to award a hardware contract to one of the three firms sometime next month.

There are a number of landing techniques that could be used to let the instrument capsule down intact on the lunar surface (AW Feb. 22, p. 31). But two of the three proposals that were submitted reportedly favor the use of the spherical, solid propellant retrograde rocket. The retrorocket would take up 200 of the capsule's allotted 300-lb. over-all weight and a sensing system will have to be developed that will fire the rocket at the proper height above the moon. None of the three capsule bidders, however, apparently considers either of these problems an especially significant drawback.

The major attraction of the spherical solid propellant rocket engine for this application is its high mass ratio (the ratio of propellant weight to total engine weight). Compared with a mass ratio of .75-.8 for the conventional cylindrical rocket, the spherical engine offers a mass ratio of .9 in the small sizes (200 lb.) required for this application and using off-the-shelf materials and components. The principal objection to spherical engines, their large frontal area and drag in the atmosphere, becomes relatively unimportant in space and retrograde applications.

NASA, which developed and has been using small (5-in. diameter) spherical solid propellant engines (AW Oct. 26, p. 54), awarded Thiokol Chemical Corp. a $50,000 contract last winter (AW Nov. 16, p. 33) for the development and production of larger spherical engines. Thiokol's Elkton Division now is ready to deliver 25-in. diameter spherical engines to the government and has a 40-in. diameter engine in later stages of development.

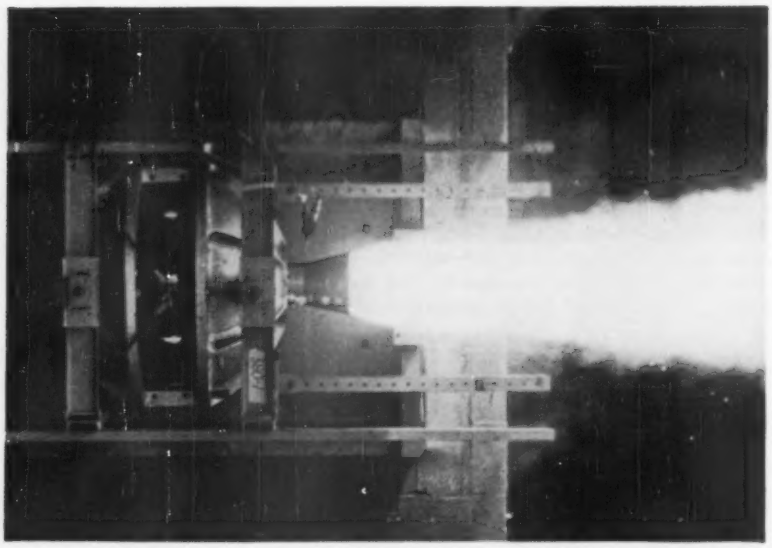
Engine Limit

At this point, Thiokol scientists feel confident that the only limit to the size of the spherical engines is that imposed by the aerodynamic fairing which could be used on the launching vehicle to cover the spherical engine and eliminate drag. For the Ranger program, however, a small spherical engine—one with a 20-25 in. diameter and weighing 200-300 lb.—now is considered adequate. An engine of this size could produce better than 7,000-lb. thrust.

Development of the larger 25-in. and 40-in. diameter spherical rocket engines posed a number of major problems which Thiokol says now have been successfully solved. Possibly the most unusual and difficult of these was that of core removal after the grain had been cast. To take advantage of the weight-saving potential offered by spherical design, Thiokol scientists had to keep the diameter of the heavy nozzle attachment flange to a minimum.

In effect, this meant that the core had to be removed through a nozzle opening smaller than its own diameter. Thiokol compares the problem to that of removing a model ship built inside a bottle but will not say how the problem is actually solved. As one propulsion engineer points out, however, it could not be done using a rigid core structure.

Another problem was design of the propellant charge. Unlike a conventional propellant grain that burns in two dimensions, the charge in a spherical engine must burn in three dimensions at once. After a great deal of model carving to help them visualize the situation inside a spherical grain, Thiokol



THIN-WALLED, high mass ratio spherical engine requires special handling and firing harnesses. An engine 25 in. in diameter and weighing 200-300 lb. is capable of producing more than 7,000-lb. thrust.

scientists came up with what is basically a radially burning star configuration. Also, Thiokol had to modify the physical properties of its polysulfide fuel-binder and its curing operation to minimize thermal shrinkage and pull-away, which is most critical in the curved end sections of a conventional, cylindrical solid propellant rocket engine and, of course, equally critical all over a spherical engine.

Fabrication of the spherical rocket case also posed a problem. The 4130 steel which is used to make the cases is normally oil-quenched. The problem arose in obtaining an even, simultaneous quench inside and outside the case. A somewhat cumbersome solution was arrived at by force-feeding the quenching oil into the interior. In the future, Thiokol may go to air-quenched steels which would eliminate the problem and at the same time give yield strengths greater than the present 180,000 psi.

Thiokol expects to complete its present NASA contract in approximately six months or less. Meanwhile, the company is doing considerable work in this area on its own, including such things as using the more sophisticated Minuteman ICBM propellants in the spherical engines and experimenting with higher strength steel cases. The company has even carried out paper studies on spherical engines up to 15 ft. in diameter.

The spherical solid propellant rocket engine, Thiokol feels, has potential applications ranging from small spin and attitude control motors to upper stages for the Scout and Minuteman vehicles. As an upper stage, this engine could cut down over-all vehicle weight or, more important, enable the same weight vehicle to put a greater payload in orbit or on target.

SPHERICAL solid propellant rocket engine developed by Thiokol under NASA contract may be used to slow instrumented capsules for rough lunar landings.

Missile Test Ship Tracks Transit IB

Washington — Navy-Advanced Research Projects Agency Transit IB is being tracked by the USS Observation Island missile test ship off the Florida coast in the first operational experiments designed to lead to an orbital navigation satellite that can provide accuracies to within one-tenth of a mile.

The Observation Island, equipped to test-launch the Polaris fleet ballistic missile, will not attempt to actually navigate with the doppler shift data it receives from the Transit IB since the satellite does not contain a memory unit needed to store fixes received from ground stations on its precise orbit and then retransmit them (AW Apr. 18, p. 29).

The doppler shift, however, will be recorded and plotted to determine just how accurately the ship could have navigated had it relied upon the transit data.

Navy and Johns Hopkins University's Applied Physics Laboratory, which has technical direction of the program, hope to obtain accuracies on the order of one-half mile with the Transit IB and two subsequent test vehicles. One-tenth-mile accuracies will be obtained, Navy hopes, with smaller, operational versions of the Transit equipped with the memory unit under development by Applied Physics Laboratory.

Serious experiments with the Transit IB were begun last week when the satellite was successfully stabilized in its orbit seven days after launch.

The satellite was initially slowed from 178 rpm. to 4 rpm. when a preset timer released two small weights, which were located opposite one another along the sphere's mid-section and attached to the vehicle by lengths of cable.

As the weights flew outward, the force applied a torque to the satellite, reducing the spin. The cables were then automatically severed from the satellite and the weights ejected.

Transit IB was later slowed to a point a Navy spokesman described as "completely stationary within any ability to measure movement" by four highly permeable iron rods which braked the satellite as they attempted to align themselves with the earth's magnetic field.

The signals from the two transmitters aboard, which are broadcasting on four frequencies, had been erratic while the satellite was spinning but cleared immediately after stabilization was achieved.

The satellite had been allowed to spin during the first seven days of its orbit to accommodate a "piggy-back" experiment to prove the infrared albedo level of the earth.

Of the two remaining Transit test vehicles scheduled for launch before introduction of operational satellites, Transit II is scheduled to be fired into a high-altitude orbit in May, Transit IIB into a low-latitude orbit in November.

Transit II will be used primarily to study the effects of the Aurora Borealis on frequency transmissions, Transit IIB to determine the gravitational forces to which a satellite is subjected.

British Group Proposes Joint Space Authority

London—Commonwealth Space Authority has been proposed by British Interplanetary Society to work with the U.S. on space projects and retain a space technology capability that has been crippled by the cancellation of Blue Streak (AW Apr. 18, p. 28).

Society suggested that the British government negotiate with Australia and other interested Commonwealth nations to form a group that would maintain the British and Commonwealth interest in the space field. B.I.S. also suggested that France, West Germany and other North Atlantic Treaty Organization nations might be interested in joining such a venture.

British space group said the most disturbing aspect of the government decision to cancel Blue Streak lies in the lack of an immediate plan for salvaging the skills developed under the missile program. B.I.S. feels immediate action is required to initiate a space program based on Blue Streak, the Black Knight research vehicle and the range facilities at Woomera, Australia.

Space Technology

Geodetic Beacon Planned for Transit IB

By Philip J. Klass

Washington—First space-borne test of a geodetic satellite system is planned as a "hitch-hike" experiment aboard the Navy's Transit IB navigation satellite scheduled for launching late this year.

Precision tracking system known as Secor (Sequential Collation of Range) made by Cubic Corp., of San Diego, has been selected by Army Engineers Corps Map Service for the forthcoming tests. Army Map Service provides geodetic service to the three military services.

The only satellite-borne instrumentation required by Secor is a small, six and one-half pound transponder. This permits the geodetic function to hitch-hike aboard military satellites such as Transit IB, which have other primary missions.

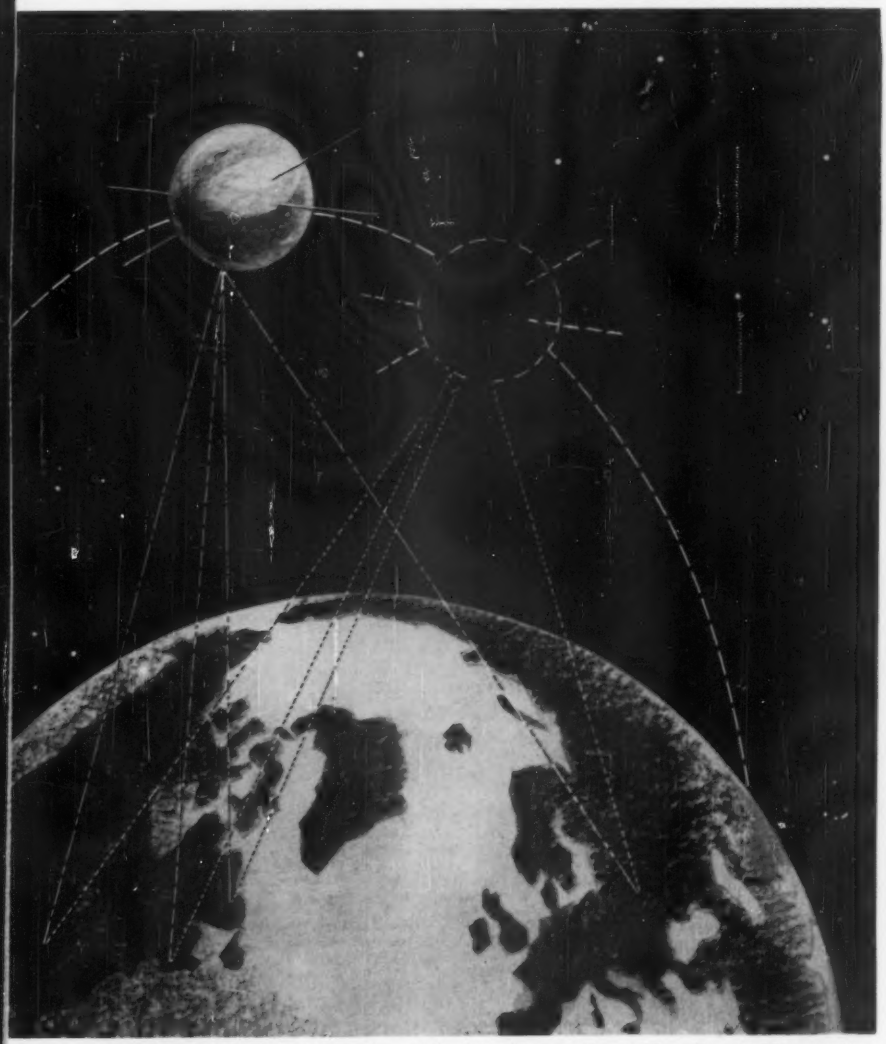
A geodetic satellite is expected to permit accurate correlation of the many different national geodetic datums, providing more accurate data on the relative location of cities, islands and landmarks around the globe. The geodetic satellite also is expected to provide a more precise determination of the earth's shape and gravity field. All of these are important for improving the accuracy of ballistic missiles.

Precise location of targets is not required for manned bombers which can home on the target using visual and/or radar landmarks. But, because the ballistic missile has no terminal guidance, prior knowledge of precise target position relative to launching site is required, especially for hardened targets.

Geodesists are now attempting to tie in the many national and small-area datums into three major datums—North American, European and Tokyo. Even with the best of optical and radio surveying techniques, there is a buildup of errors in the process, particularly over large bodies of water where optical techniques cannot now be employed.

A recent Air Force study indicates that the uncertainty of position of a point on one major datum relative to a point on another is approximately 400 to 500 ft. Add to this the errors within the major datums and some observers estimate that the area of uncertainty of the location of a major landmark in Russia relative to a point in the U.S. may be as great as one-quarter of a mile.

The use of a geodetic satellite equipped with Secor should make it possible to cut the present uncertainty by a factor of 10:1 or better, according to Cubic Corp.



GEODETIC SATELLITE tests planned for late this year aboard Navy Transit IB navigation satellite will use Secor system to measure satellite position relative to three stations whose position is known, one whose position is unknown.

Two Approaches

There are two basic approaches to the application of a satellite for geodetic purposes:

- **Orbital method** requires extremely precise determination of satellite orbit, including minor variations from the Keplerian ellipse, and then uses this information as a measuring rod for connecting the various datums over which it passes. This provides great freedom in the location of sighting stations but requires extremely precise knowledge of the instant in time when each sighting is made.
- **Inter-visible method** uses satellite as a point of simultaneous observation from known and unknown datums. It does not require precise knowledge of the satellite ephemeris but does require simultaneous sightings from several locations.

The Secor system is particularly suited to the inter-visible method but also can be used for the orbital method, or a hybrid combination of the two approaches. Army Map Service probably will try both techniques, using the orbital method for correlating between locations so widely separated that a satellite cannot be viewed simultaneously from all stations.

As applied to the inter-visible method, four identical Secor ground stations will be employed. Three of them, which serve as a reference, will be located, as nearly as geography permits, at the vertices of an equilateral triangle whose legs are about 1,000 mi. long. For example, one station might

be located in New York, another in Chicago and the third in Charleston, S. C.

The three station locations would be precisely surveyed relative to the North American (or other) datum to be used as a reference.

The fourth Secor station can be situated on any unknown location up to several thousand miles away, the distance being limited only by the need to view the satellite simultaneously with the three reference stations. This separation distance is a function of satellite orbital altitude and how close to the horizon it can be viewed without difficulty.

For instance, if the satellite altitude is 1,500 naut. mi., with the three reference stations located as indicated above, a fourth Secor station could be located along the west coast of Africa or Europe, and could locate the position of Paris, London or Casablanca with an error of less than 100 ft., it is believed.

Each of the Secor ground stations determines the distance of the satellite by transmitting a frequency-modulated, continuous-wave signal which is repeated back by the satellite transponder at an offset carrier frequency. Each ground station determines satellite distance by measuring the phase shift between the transmitted and received signals. To provide a means for compensating for errors introduced by ionospheric refraction, the transponder replies on two different carrier frequencies.

Ideally, the four Secor ground stations should simultaneously interrogate the satellite, but this would require four transponders. Instead, the stations transmit in a synchronized sequence which is repeated many times per second. The use of dynamic smoothing of the distance-to-satellite information at the ground stations permits interpolation to provide the equivalent of simultaneous sightings by all stations, according to Cubic Corp.

During passage of the satellite, Secor stations will be making repeated distance measurements, rather than just a single determination, making it possible to obtain more accurate data through a smoothing or averaging process.

The company now has a Secor system installed at Eglin AFB, Fla. The system which will be provided to the Army is a slightly modified version with improved timing accuracy and greater receiver sensitivity to permit operation at ranges out to 10,000 naut. mi.

Space Technology

Soviet Space Weapons Predicted To Re-Enforce Ballistic Missiles

By Ford Eastman

Washington—Hypersonic bombers, boost-glide and satellite-type weapon systems may re-enforce the Soviet Union's ballistic missile capability in the post-1965 period, the Army's director of air defense and special weapons predicted at a congressional hearing last week.

Brig. Gen. John T. Snodgrass outlined the growth, and the changes to be expected, in Soviet military capabilities over the next 10 years in a prepared statement given to the Senate Armed Services Subcommittee on Military Construction headed by John Stennis (D.-Miss.). He said:

"The ballistic missile threat to the continental United States reaches serious proportions by 1961 and, by 1963, the intercontinental ballistic missile will have become the predominant intercontinental nuclear delivery vehicle of the USSR. In the post-1965 period, a satellite threat will probably be present also, and the Soviet ICBM capability will be significantly improved."

Supersonic aircraft, small supersonic air-to-surface missiles, advanced penetration aids and highly developed tactics will qualitatively increase the air threat to the U. S. in the 1960-1965 period, Gen. Snodgrass said. However, by the end of 1966, he added, "it is expected that the Soviet bomber force will be substantially reduced and its composition altered. Hypersonic bombers or boost-glide and satellite-type weapon carriers may become operational.

"In the post-1965 period," he told the subcommittee, "nuclear submarines capable of submerged launching of intermediate range ballistic missiles will probably be available in significant numbers. Also, several types of space vehicle detection, reconnaissance and control systems should be operational."

To meet both the air-breathing and ballistic missile threat, Gen. Snodgrass said the Army needs a family of three weapon systems similar to those recommended under Defense Department's master air defense plan drafted last year. They are:

- **An anti-missile missile** weapon system "to destroy ICBMs, other ballistic missiles and satellites."
- **"An improved surface-to-air missile** system to defend against qualitative increases in the air-breathing threat, to include massive electronic countermeasure carriers and sophisticated electronic penetration aids; long range, high speed, small cross section air-to-surface missiles, and submarine-launched cruise missiles.
- **"A manned long-range attrition** weapon system capable of independent operation, containing its own long-range radar and capable of multiple engagements with air-to-air missiles."

An added factor in effectively countering the Soviet ICBM threat, Gen. Snodgrass said, is the Soviet emphasis on mobility. He said:

"We believe that the Soviets will provide mobility for a significant portion of their ICBM forces and reduce their vulnerability further through dispersion and concealment," he said.

Gen. Snodgrass said that, in the Army view, the threat can only be countered by an active defense and that the Nike Zeus anti-ICBM system will fulfill this requirement. He added:

Meanwhile, in testimony before the Senate Space and Preparedness Committees released last week, Air Force witnesses strongly urged restoration of the North American B-70 Mach 3 bomber development program as a complete weapon system. The witnesses included Gen. Thomas D. White, Air Force chief of staff, and Gen. Thomas S. Power, commander of the Strategic Air Command.

Gen. White said he feels that it would be "highly desirable" to go on with the B-70 program as a weapon system "as rapidly as feasible."

The Administration has requested $75 million in Fiscal 1961 to partially fund the building of one prototype aircraft and the beginning of another. Gen. White said an additional $360 million would be required in Fiscal 1961 to reorient the program to a weapon system development.

Development of the B-70 system would provide SAC with an effective replacement for the Boeing B-52 when it becomes obsolete, Gen. White said, and also provide these other potential uses:

- **Launching platform** as a first stage booster for military earth satellites, including USAF's Midas infrared detection vehicle and civilian satellite projects.
- **Conversion to nuclear power.** Its configuration is such that, with certain types of nuclear reactors, it could be adapted to nuclear propulsion.
- **Anti-satellite defense.** Armed with the proper ballistic missile, the B-70 could provide a simpler means of intercepting satellites which, Gen. White said, may become a military requirement in the future.

Douglas Hints New Financing Need; Stockholders Quiz Curtiss-Wright

Equity financing as a possibility for Douglas Aircraft to raise new money or for acquisitions was one development at company's annual meetings last week that also saw critical questions tossed at Curtiss-Wright Corp. management.

Issuance of an additional 3 million shares of capital stock was authorized by Douglas stockholders with the date and purpose of the issue left up to the board of directors. It was revealed that the price for new DC-8 orders will go up 5% June 1.

If Douglas management exercises the authority granted by the stockholders, it would raise the total number of shares outstanding to 8 million. Donald W. Douglas, Jr., said that management wanted the authority to make possible a stock issue, if needed, for new financing or for acquisitions of other companies. He said there are no firm plans for new financing or mergers. Before the new authorization was voted, the company had 689,796 shares authorized but unissued and unreserved.

The stockholders were told of the retirement of Arthur E. Raymond, who was senior vice president-engineering since 1958, and a major reorganization of the corporation's top echelon engineers. Raymond also was reported to have sold 8,000 of the 9,000 shares of stock he held in the company. He was hired by Douglas as a metalworker in 1925.

His successor will be Edward F. Burton, formerly vice president-engineering for transport aircraft. Burton will receive technical assistance from Elmer P. Wheaton, who has been vice president-engineering for missiles and space systems. Administrative assistance will be supplied to Burton by Robert L. Hoskinson, who has been director of flight and testing.

In another move of top company officers, Collier trophy winner Edward H. Heinemann, vice president-engineering for combat aircraft systems, will take over as head of the company's European Division, replacing M. E. Oliveau, who will return to the company's general offices.

Douglas officials disclosed a net loss of $6,949,000 for the first quarter of 1960, and a loss of $8,117,000 for the preceding quarter.

Sales of $251 million were reported for the first quarter of the 1960 fiscal year which ended Feb. 29, compared with $226 million for the final quarter of 1959 and $227 million for quarter ending Feb. 28 a year ago.

Total backlog as of Feb. 29, was $1,413,363,000, of which $745,245,000 or 52.8% was military and $667,118,000 or 47.2% was commercial. At the end of the fiscal year Nov. 30, the total backlog was $1,317,277,000, of which $569,084,000 or 43.2% was military and $748,193,000 or 56.8% was commercial.

Douglas expects to just about break even in the next quarter and to show profits in succeeding quarters, but stockholders were cautioned not to expect high profits over the year.

Douglas has modified a two week-old order to cut wages of all salaried employes by 10% (AW Apr. 11, p. 34). The modification eliminates pay cuts for salaried employes earning less than $12,000 a year and reduces the cut to 5% for employes earning between $12,000 and $19,999. Reduction will be 10% in the bracket between $20,000 and $49,999, and 15% to 25% above that level.

Shelving of plans for the DC-9 allowed Douglas to reduce its credit line from $200 million to $150 million and save the interest, an official reported.

Heavier than expected costs on the DC-8 program were blamed for the company's heavy recent loses and the upcoming price increase. Donald W. Douglas, Jr. said, "The company has moved down the learning curve slower than we anticipated." In original planning for the airplane, cost was expected to fall below price at about the 20th airplane. Cross-over point is now expected at number 70. Production has reached its peak of eight per month.

Despite floor opposition at the Curtiss-Wright meeting, stemming from descending profits, dividends and stock values, the corporation management had no difficulty re-electing its board of directors and defeating resolutions proposing post-meeting stockholders reports and cumulative voting on directors. Two candidates were nominated from the floor, but were defeated.

Among the questions and proposals made to Roy T. Hurley, president and chairman of the corporation, were:

• **Low number of shares** held by corporate directors, four of whom hold only 100 shares. Hurley remarked that the directors were chosen for their ability to aid the company rather than on the strength of their holdings.

• **Propriety of dividend cut** notices with announcements of new product development. This referred to events of last November, when a dividend cut followed announcement of a German-licensed engine development which caused a sudden rise in stock prices. Hurley denied any intent on the part of management to manipulate the stock price and suggested that had the engine announcement been held until after the dividend cut, the same charges in reverse could be brought. Security and Exchange Commission records show that in October, 1959, Lloyd H. Smith, director, disposed of 7,100 shares of stock. In November, officers James G. Byron sold 3,000 shares, Nicholas Dykstra sold 100 shares and William T. Lake sold 300 shares.

• **Management salary cuts** were proposed by some stockholders as a means of conserving money and distributing the pain of dividend cuts. Hurley said that salary levels must be sufficient to acquire and retain competent personnel and that he regarded general salary cuts as an "act of desperation" on the part of management. Curtiss-Wright paid Hurley $329,500 in 1959, a sum which included installments on incentive compensation awarded during 1955-1959.

• **Charges of being ignored** by Curtiss-Wright were made by many stockholders, who said that letters requesting explanations of corporate policy were not answered.

Hurley expressed confidence in the company's future, saying that the rotating combustion engine, and proposed VTOL aircraft (AW Apr. 18, p. 73) had excellent potential as profit earners for the company, along with other company products. When pressed as to when these profits would appear in the balance sheets, Hurley declined to make any forecasts.

The corporation choose the stockholders meeting to announce successful flight testing of a VTOL aircraft employing Curtiss-Wright radial lift force propellers (AW Apr. 18, p. 73). Films of the aircraft, designated Model X-100, showed a tilting nacelle design with two propellers mounted on stub wings. The test vehicle demonstrated vertical take-off with vertical nacelles and forward flight with the nacelles tilted about 20 deg. from the horizontal. The propellers are designed to produce lift in forward flight with the nacelles horizontal. Powerplant for the test vehicle is a turboshaft engine.

Stockholders also were shown models of the corporation's VTOL aircraft. These four engine designs provide pitch control by mounting the engines on stub wings forward and aft on the fuselage. Pitch control on the two-propeller test vehicle is provided by means of a jetevator beneath the aircraft's T-tail.

Models displayed at the meeting included a 6-place executive VTOL, designated Model 200, and a local service transport VTOL, the Model 300. No forecasts were made regarding aircraft development time.

Textron to Buy Bell Defense Divisions

New York—Purchase of Bell Aircraft Corp.'s defense business proposed by Textron, Inc., is the latest in a series of aggressive diversification and acquisition moves by Textron in a program that had its beginnings in 1952.

Textron would acquire Bell's Niagara Frontier Division with rocket engine and electronics capabilities; Bell Helicopter Corp., Ft. Worth, Tex., and Hydraulic Research and Mfg. Co., Burbank, Calif., electro-hydraulic servo systems and valves, for the cash equivalent to their note book value, estimated at $30 million.

Bell, which had reorganized itself into the Bell Defense Group, consisting of the three defense divisions to be sold, and the Bell Commercial Group, which will be retained. This group of five companies in the industrial products field—Wheelabrator Corp., Lake Erie Machinery Corp., Lord Chemical Corp., W. J. Schoenberger Co., and Birma Mfg. Co.—has contributed a relatively small share of Bell's total sales volume but a larger share proportionately of earnings.

Textron will rename the Bell Defense Group as the Bell Aerospace Corp. It will operate with an independent board of directors with present management.

This follows Textron's pattern of avoiding centralized control and leaving its 24 separate companies the maximum operating leeway. Its philosophy against a burdensome and rigidly functioning central staff is illustrated by the fact that only 70 persons are employed at company's corporate office in Providence, R. I. Textron, with sales of $308 million in 1959 and earnings of $16.6 million, had a product breakdown last year of 24% consumer goods, 22% industrial, 21% textile, 20% automotive and 13% defense. Its acquisitions are part of a plan due to be completed in 1962 aimed at increasing its defense volume to about 20% of the total. Thus the company appears to want a diversification breakdown of roughly 20% in each of these five areas.

Textron believes it will supply greater cash flow resources to sponsor research and development programs than Bell had formerly. Space will be big business in the future, Textron believes, and Bell's rocket and electronic capabilities will be used as a base to build on to win a share of this market.

Helicopters are another possible growth avenue, and Textron may decide to sponsor development of a commercial turbine helicopter based on the HU-1 in the 12-passenger class, which Bell has not undertaken.

No specific program lies behind the proposed purchase, however. Textron is primarily interested in building earnings—return on investment rather than return on sales. Though research and development type business is noted for a low margin on sales, Textron feels the return on its investment in Bell will be eminently satisfactory.

Textron feels the engineering talents it will obtain will be an important factor in meeting competition for defense business, and that its willingness to provide capital to back such skills will be a strong asset in a climate heavily oriented toward R&D contracts. Like many companies seeking to acquire expanding defense capabilities, Textron chose to buy existing capabilities rather than develop its own from scratch.

Textron has retained earnings and capital surplus of more than $100 million which could be used to buy Bell, and it might also draw on bank credit. It canceled an unused $30 million line of bank credit at the end of 1959 since the acquisitions it had hoped to make did not materialize by year end.

Bell stockholders must approve the sale, but since 51% is held by Equity Corp., financial sources here regard the approval as a foregone conclusion. These sources regard Equity Corp.'s lack of interest in heavy R&D investment as a reason for the defense company sale and for the retention of the commercial companies, which do not require this same degree of investment.

Textron bought five companies last year and one this year for $21,679,000. In addition, it has set up Textron Electronics as a subsidiary in which it holds controlling interest. Textron has transferred several electronics companies it owned to the subsidiary in exchange for stock, and the subsidiary itself acquired Globe Electronics, Council Bluffs, Iowa, last year for stock.

Piper, Beech Make Stock Moves

Piper Aircraft Corp. and Beech Aircraft Corp. took major steps in the financial area last week, both of which produced negative reactions in a soft stock market.

Piper filed with the Securities and Exchange Commission plans to offer 100,000 shares of stock to finance repayment of a $1 million bank loan obtained to carry increased receivables and inventories, $1.5 million for completion and equipping of its research center in Vero Beach, Fla., and $500,000 for construction of an engineering building and purchase of additional equipment at its Lock Haven, Pa., factory and for other expansion. Piper stock, which had hit a high of $66 a share, dropped five points on the news and sold off further later in the week.

Beech directors approved a three-for-one stock split and indicated a dividend increase, but Beech stock dropped two points even on the good news. Since the step had been expected, the drop may have been part of a general market decline in progress.

Stennis Asks 'Cushion' In NASA Budget

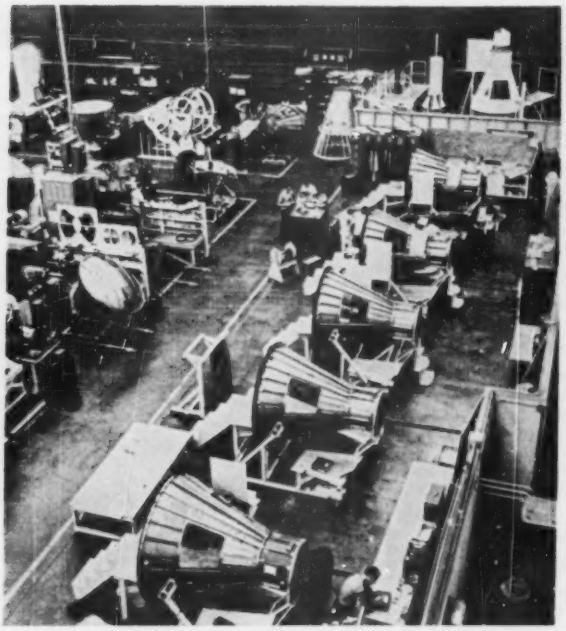
Washington—Sen. John Stennis (D.-Miss.), a member of the Senate Appropriations and Space committees, last week proposed a $30 million "cushion" in the Fiscal 1961 research and development budget of National Aeronautics and Space Administration to meet unanticipated costs during the year that could result from possible new discoveries or launching failures.

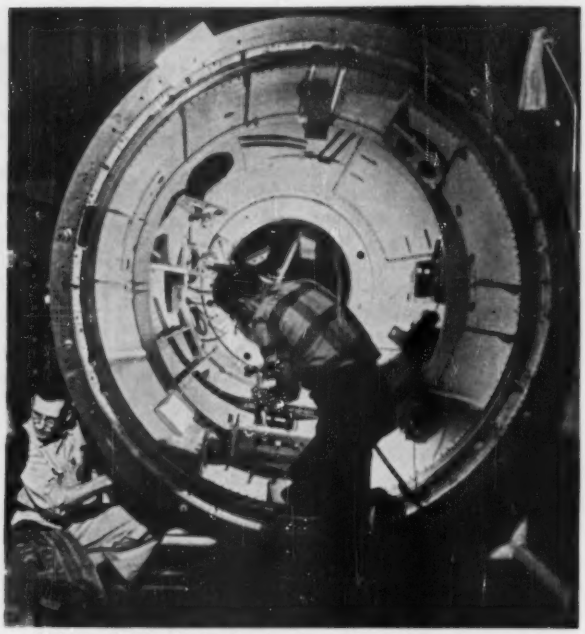
Stennis' proposal to increase the Administration's $621 million request for NASA research and development to $651 million followed a $19.2 million reduction in the amount by the House. The $602 million approved by the House for research and development is $267 million above the Fiscal 1960 budget figures, however.

The $19 million House reduction included $2.1 million from requests for funds for scientific investigations in space, $1.4 million from meteorology and communications satellite proposals, $2.7 million from manned space flight; $1.2 million from vehicle systems technology and $1.6 million from tracking and data acquisition requests. Full $134.3 million for the 1.5-million-lb.-thrust Saturn was approved.

NASA's over-all budget request of $915 million—as compared with approximately $500 million for Fiscal 1960—was reduced to $876 million by the House (AW Apr. 18, p. 37).

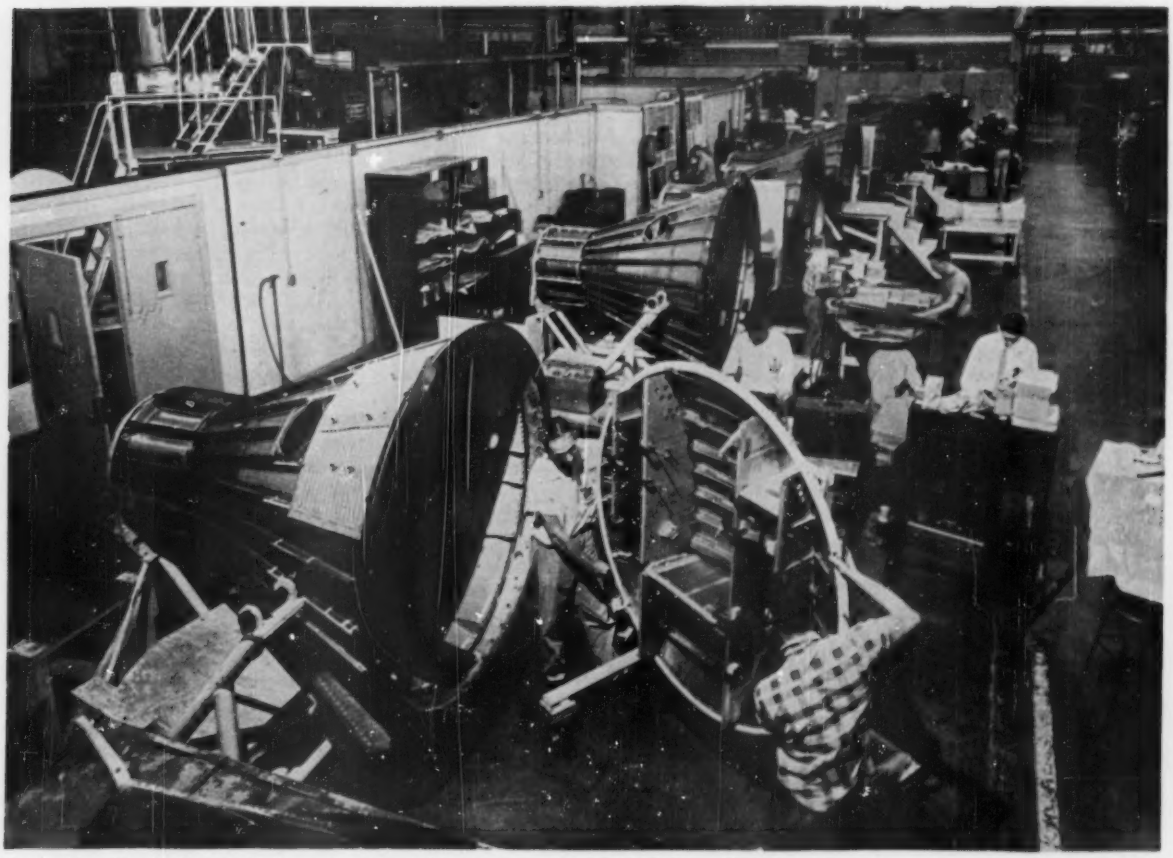
The House's $15.5 million cut in NASA construction funds eliminates $435,300 for a publications library, and technical services building at the Jet Propulsion Laboratory, Pasadena, Calif., and funds for several proposed facilities at the Marshall Space Flight Center, Huntsville, Ala., including a central laboratory and office facility, completion of a guidance and control building and additions to the fabrication laboratory.



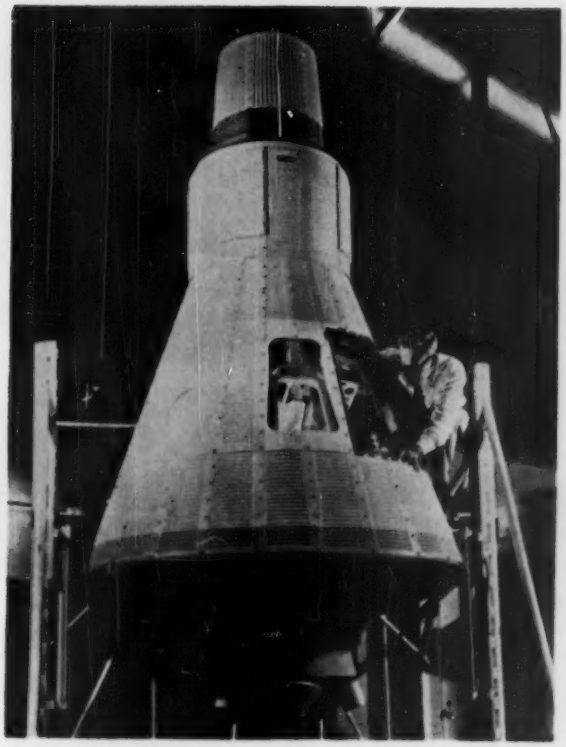


Project Mercury capsules are assembled on production line at McDonnell Aircraft Corp.'s St. Louis plant. Capsule fuselages are constructed with a titanium inner skin corrugated for stiffness. Corrugated outer skin of nickel-base alloy is installed over aluminum stringers. First completed capsule stands with its escape rocket at end of line. Hatch on side will be an emergency exit (see pages 88-89).

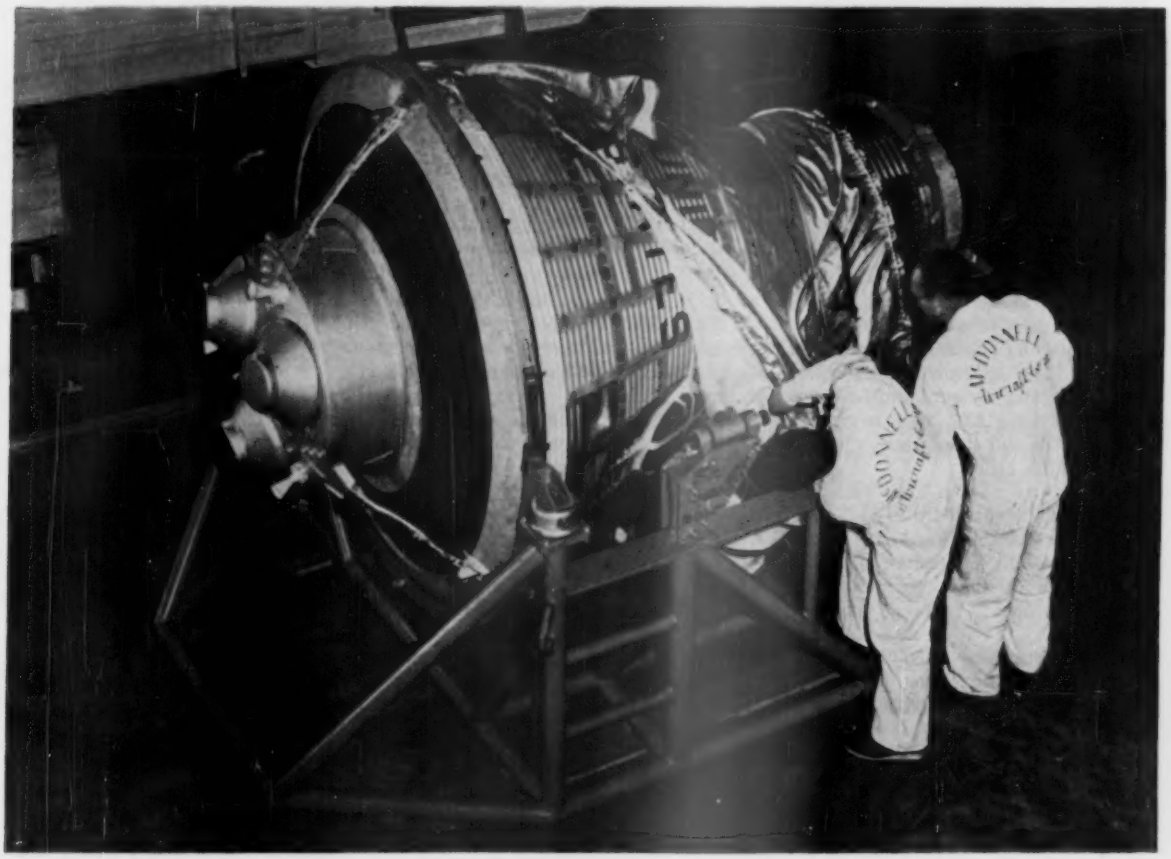
First Photos Show Mercury Capsule Production



Outer skin plates being installed on the nearest Mercury capsule are shingled to allow for thermal expansion. Capsule floor, which workmen are moving into position, will be covered by an ablative fiber glass and resin heat shield for protection during re-entry.



Completed Mercury capsule was delivered to NASA and airlifted in a C-124 to the agency's Wallops Station. There the capsule, minus some of its internal systems, will make its first flight on a Little Joe booster in a test which will include a trial of the emergency escape rocket system. McDonnell currently has orders for 20 capsules, and NASA plans to have spent $105 million by the end of Fiscal 1961 on development and production of the Mercury capsule and for support equipment and services.



First Photo Shows Military Version of Dassault Communaute

Dassault Spirale, military version of the Communaute transport (AW Jan. 29, p. 119), carries two ventral pods each containing a 30 mm. cannon with 200 shells. Aircraft has made its first flight. Provision is made to carry three rocket pods under each wing. French government has not placed orders for either the civil or military version. Both aircraft are powered by two Turbomeca Bastan turboprops, each developing about 935 eshp. at takeoff.

Bunker Predicts Continued Growth For Martin; Diversification Cited

New York—Martin Co.'s sales and earnings are expected to show the same growth for the rest of 1960, compared with 1959, as they did for the first quarter, Chairman George M. Bunker told the New York Society of Security Analysts last week.

Research and development business—which means lower profit cost-plus-fixed-fee contracts—are a way of life now for the defense industry and even maintaining earnings in the future will require increases in sales volume, Bunker noted. Martin now has about 80% cost-plus contracts, and though higher profit fixed-price and target-incentive contracts will begin to play a larger role next year, he did not foresee a radical change in this ratio.

Martin's first quarter 1960 sales were $140,839,907 compared with $122,332,650 for the same quarter last year, and earnings for the 1960 quarter of $3,488,112 or $1.13 a share, compared with $3,038,470 or 99 cents a share last year.

Bunker discussed what he termed Martin's successful efforts to diversify in obtaining rising sales volume and its broad program in the missile field. Points he made, some in response to questions:

• **Martin** now owns about 14% of the voting stock of General Precision Equipment Corp., both common and preferred included. Investment in this stock is $9-10 million. Two persons not connected with Martin were proposed to GPE by Martin as directors, but GPE took no action on the recommendations.

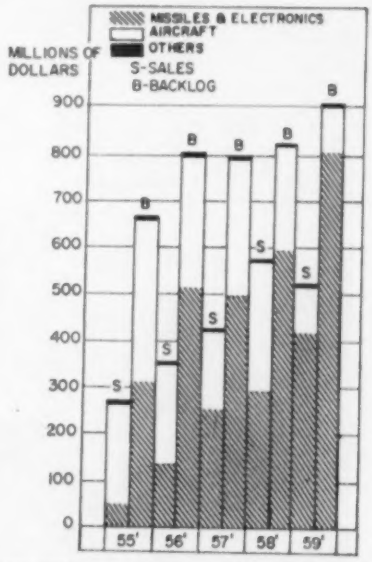
• **Three Martin missile systems** may be bought for use by NATO. Germany already has placed a $100 million order for Mace, which will be bought through the U.S. Air Force and will mean about the same to Martin financially as any USAF contract would. The other two systems were not named, but Lacrosse and Bullpup are possible choices.

• **Missile Master Junior** is a version of Martin Missile Master control system contemplated for use in point defense of sites in Europe smaller than the 10 continental U.S. cities where the Army Missile Master is used.

• **Changeover** to the Titan-N (noncryogenic) storable propellant intercontinental ballistic missile for in-silo launch, decided on two years ago, will entail an interruption in Titan production about two years from now. Unit costs of Titan, not including development costs, are only a small percentage higher than those for Atlas figured on the same basis.

• **Marine Corps** interest in Lacrosse centered on a version called Modification One which used a guidance system tailored to Marine requirements. Marine interest in this development was stopped two years ago, but recent "criticism" of Lacrosse on the grounds that the guidance was unsuitable for the Marines was based on this past history, Bunker said.

• **Dyna-Soar sales volume,** if the program is implemented, will be substantial. Bunker feels the program will have to be pursued for the U.S. to remain in competition with the Russians in the area of hypersonic flight.



CHANGE in sales composition, backlog of The Martin Co. is indicated in this chart based on data in company's annual report.

TACTICAL COMMUNICATIONS:

* CRIMEA 1854 *

...'Forward the Light Brigade!
Charge for the guns!' he said.
Into the valley of Death
Rode the six hundred.

...Was there a man dismay'd?
Not tho' the soldier knew
Someone had blunder'd.
Theirs not to make reply,
Theirs not to reason why,
Theirs but to do or die.
Into the valley of Death
Rode the six hundred.

...Cannon to right of them,
Cannon to left of them,
Cannon behind them
Volley'd and thunder'd;
Storm'd at with shot and shell,
While horse and hero fell,
They that had fought so well
Came thro' the jaws of Death...
...All that was left of them,
Left of six hundred.

ALFRED LORD TENNYSON

RICHARD CATON WOODVILLE, JR. "Charge of the Light Brigade." Parker Gallery, London

Blundering tactical command in this age of quick-reaction military operations may not be similarly immortalized. Today, instantaneous and completely reliable Electronic Communications, both voice and tactical data link, provide the continuous two-way intelligence that precludes the blunders which sealed the fate of the Light Brigade.

ECI is proud to play an important part in insuring that such Electronic Communications exist for our defense in space, airborne and surface roles, with the creation of systems such as its fully integrated Model 28, 1 KW UHF Communication equipment, capable of inclusion in advanced Tactical Data Systems, as well as in airborne applications and in the nation's continually expanding systems of Early Warning.

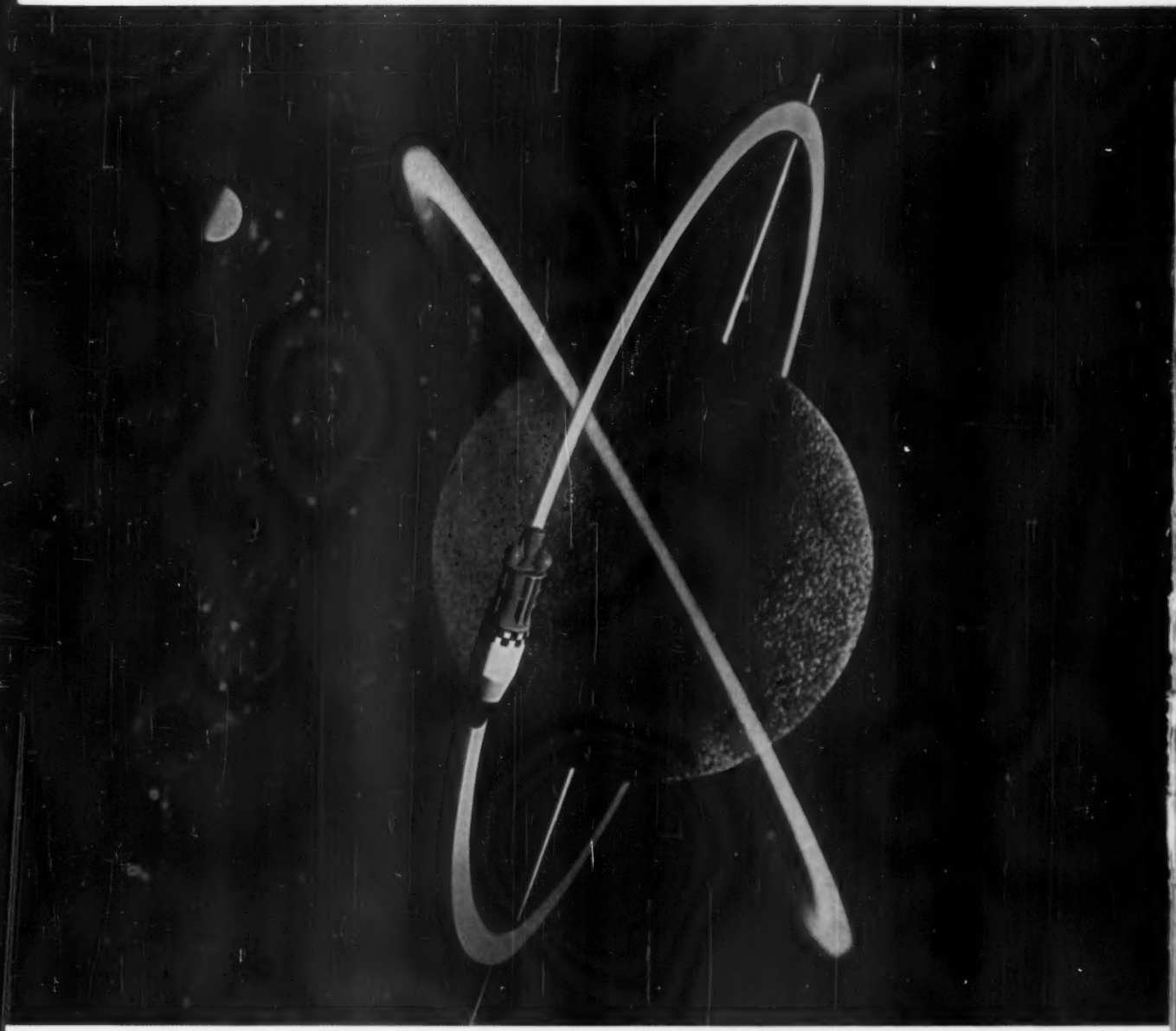
One of a series of advertisements depicting historic incidents in military communications through the ages

Regional Offices:

ELECTRONIC COMMUNICATIONS INC. *St. Petersburg, Florida*

Specialists in Systems Development, Advanced Voice and Data Link Communications, Countermeasures, Secure Communications and Related Equipment

Washington, D.C., Teterboro, N.J., Boston, Mass., Dayton, O., Dallas, Tex., No. Hollywood, Calif.



Bell-powered Agena satellites in orbit — symbolized.

THE ENGINE WITH THE FUTURE

Reliability . . . Efficiency . . . Flexibility.
In space, these words have a million-dollar meaning.

Vast sums of money and vital scientific data ride on these built-in attributes of Bell Aircraft's rocket engine for Lockheed's Agena satellite, second stage of the Air Force Discoverer series.

The Agena engine, designed with space in mind long before space became a household word, has fulfilled its every mission and has placed more tons of useful payload into orbit than any other power plant. Its operational reliability is backed by six years of development and 5,000 test firings.

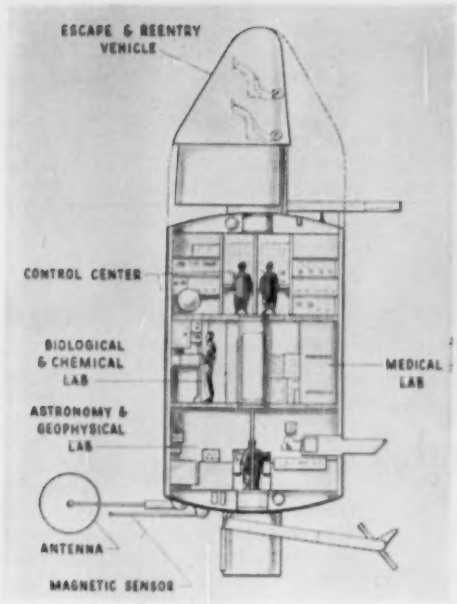
This Bell engine now has re-start capability — the first in the nation. This means that its satellite can change orbit **in space** without the penalty of extra engines. Presently in production, this engine also is adaptable to new fuels and new assignments and, consequently, is programmed for important military and peaceful space ventures of the future.

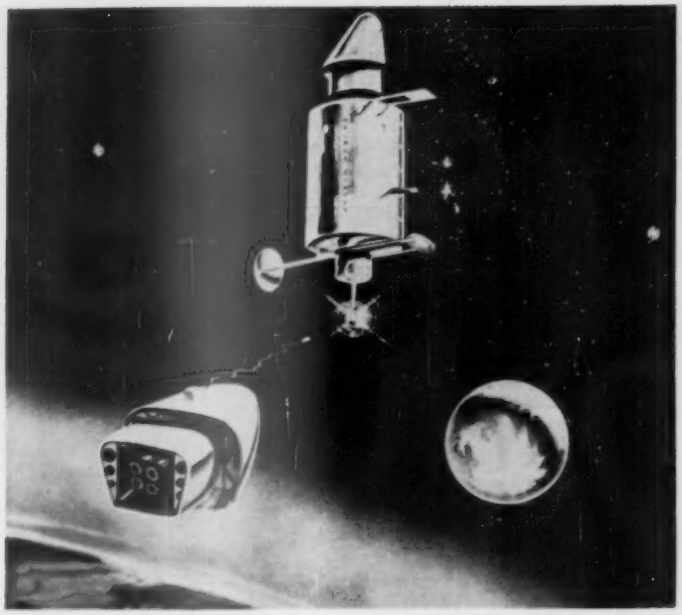
Agena's engine is typical of the exciting projects in Bell's rocket propulsion center. It is part of the dynamic new approach of a company that's forging ahead in rocketry, avionics and space techniques. These skills serve all government agencies. Engineers and scientists anxious for a new kind of personal challenge can find it at Bell.

Niagara Frontier Division

BELL AIRCRAFT CORPORATION

BUFFALO 5, NEW YORK





SPACE LABORATORY weighing 16 tons, proposed by Martin, would conduct experiments and other tests of equipment and materials. Resupply vehicle is guided to hookup with forward infrared device and cable which seeks heat source discharged from lab base.

Space Technology

Manned Orbital Laboratory Proposed

By Richard Sweeney

Los Angeles—Description of a manned scientific orbital laboratory which could function as both a test vehicle for materials, equipment, human factors and techniques development, as well as a monitored scientific laboratory operating in the space environment, was presented at the Manned Space Stations symposium here last week.

An operational target date of 1965 was assumed for the vehicle, which would be injected into orbit as a fully assembled, ready-to-operate unit by a Saturn-class booster, according to the presentation made by M. Stoiko, G. G. Kayten and J. W. Dorsey of the Martin Co.

Other orbital laboratory design criteria include:

- **"Shirt-sleeve" atmospheric** environment, but at zero-gravity condition for the crew.
- **Design orbit life** of at least one year with a possible five-year utility.
- **Two-to-four-week rendezvous,** resupply and crew rotation cycle, using an advanced ICBM booster.
- **Orbital altitude** of 400 mi. with apogee and perigee limits of 450 and 350 mi., an orbital inclination of 80 deg. regressing westerly one degree per day. These orbit parameters were chosen for human safety, booster capability, utility lifetime and the requirements for geophysical and astrophysical experimentation.

The Martin report was one of four delivered on space station design concepts on the opening day of the symposium, which was sponsored by the Institute of the Aeronautical Sciences, National Aeronautics and Space Administration and the Rand Corp.

Approximately 680 people registered for the three-day meeting, which also had sessions on human factors, structures, rendezvous and guidance, attitude sensing and control, power sources, utility and economics, plus status reports on Project Mercury and large booster development.

The Martin vehicle was described as a double-shell, three-compartment cylinder with convex end domes. Inner wall of 5456 aluminum alloy is designed as the vehicle load-carrying component and sealed cabin-pressurized container. Outer shell of beryllium is connected to the inner wall by thermally insulated clips and serves as meteoroidal bumper and thermal shield. Outer wall thickness is a function of meteoroid collision frequency, particle mass and the requirement for a minimum one-year safe lift. Inner and outer walls combined are regarded as providing adequate radiation shielding in the orbital altitude range selected.

Construction of the outer wall uses panels and expansion joints to allow for a temperature range of plus 500F to minus 150F. To maintain cabin walls at 60F to 90F, a set of water-filled tubes is used, capable of transporting 100,000 Btu. per hour from hot to cold wall at an incoming heat flux up to 500 Btu./psf./hr. Two water reservoirs, which also act as heat sinks for the air conditioning, are used, each having its own pump.

The orbital laboratory has three functional compartments separated by aluminum honeycomb bulkheads with airlocks. Cylindrical airlocks are provided at each end of the vehicle for entrance and exit and also serve as unprotected-space environmental test chambers.

Top deck of the orbital laboratory is the control center and maintenance area. The center deck has the medical, chemical and biological laboratories as well as living quarters, and the lower deck houses the geophysical and astrophysical laboratories, where equipment includes a 28-ft. focal length telescope using a retractable, parabolic mirror. Antennas and other external sensing devices also are retractable, with pressure shell apertures minimized by time sharing of experiments.

Cabin atmosphere is supplied by liquid oxygen and nitrogen at 10 psia. total pressure. Oxygen partial pressure is held at sea level (158 mm. Hg.) value, while air conditioning (one unit per

deck) will continuously circulate 70F air. Provisions for control of other cabin gases are lithium chloride absorbers for carbon dioxide, a vinyl sponge and filter system for water and charcoal filters for odors.

Vehicle ascent will have the first and second stages following a typical powered flight trajectory with the orbital laboratory coasting to nominal orbit altitude after burnout.

The velocity vector for the desired orbital injection will be provided by a programed third stage.

Injection limits are plus or minus 0.5 deg. on angle and plus or minus 50 fps. in velocity.

Orbital period is 97.2 min., providing total earth coverage in 12 hr., total sunlight earth coverage in one day (15 orbital revolutions), with a required viewing angle varying from zero to 75 deg. Each planet will be observable at any time during the year for periods from about one-half hour up to continuous observations. The sun will be continuously observable for 52 days twice a year, varying down to a minimum of one hour observation per orbital period for the remaining time.

Space Technology

Tapco Group Gets NASA Award For Sunflower Solar Power Unit

Washington—Tapco Group of Thompson Ramo Wooldridge, Inc., will develop Sunflower I, a 3 kilowatt solar auxiliary space power system, for National Aeronautics and Space Administration.

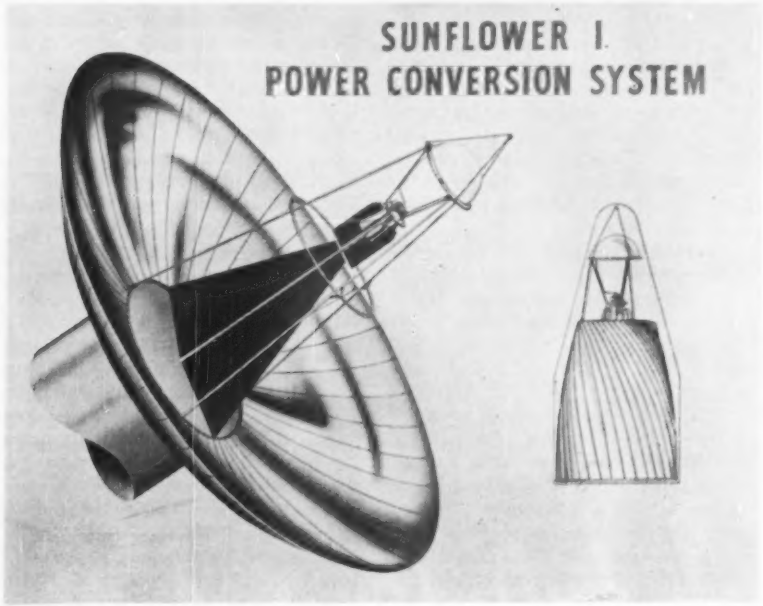
NASA will negotiate a contract with Thompson Ramo Wooldridge to develop the Sunflower system and deliver two experimental prototype systems within three to three and one-half years. Company estimates the development program will cost $4.9 million.

Solar power system is to generate three kilowatts of power for one year. The 700 lb. system will be used to supply power to the space vehicles launched by Centaur and Saturn.

Sunflower will use a foldable, petal-type solar collector that will unfold to a diameter of about 32 ft. in space. This parabolic reflector will concentrate solar heat on a boiler mounted on a 20 ft. tripod in its center. Mercury vaporized in the boiler will run through a 30 lb. turbogenerator to produce power. Turbogenerator is a modified version of the system developed for the Snap 2 experimental nuclear power system by Thompson Ramo Wooldridge.

Mercury vapor is converted back to liquid in a large condenser-radiator which will be capable of operating under weightless conditions. A lithium hydride system will store heat while the solar power system is in the earth's shadow. This system will give off enough heat during these periods of up to an hour and a half to produce electric power.

Sunflower system will require a sun-seeking orientation system and an attitude control system to keep it pointed toward the sun within a deviation of less than one degree.



NASA'S SUNFLOWER will consist of a 32-ft. parabolic petal-type solar collector, will weigh about 700 lb. and will generate 3,000 watts of electrical power for about a year.

GE, Avco Receive Plasma Engine Awards

Washington—Avco Corp. and General Electric Co. were chosen last week by National Aeronautics and Space Administration to do engineering and preliminary development studies on 30 kilowatt plasma arcjet engines.

Plasma engines will be designed to produce about one-half pound of thrust over periods of several months and will be used for travel into space from earth orbits. They will draw electrical power from the Snap 8 nuclear auxiliary power system or a similar source. Work will be conducted by Avco's Research and Advanced Development Division and GE's Flight Propulsion Laboratory.

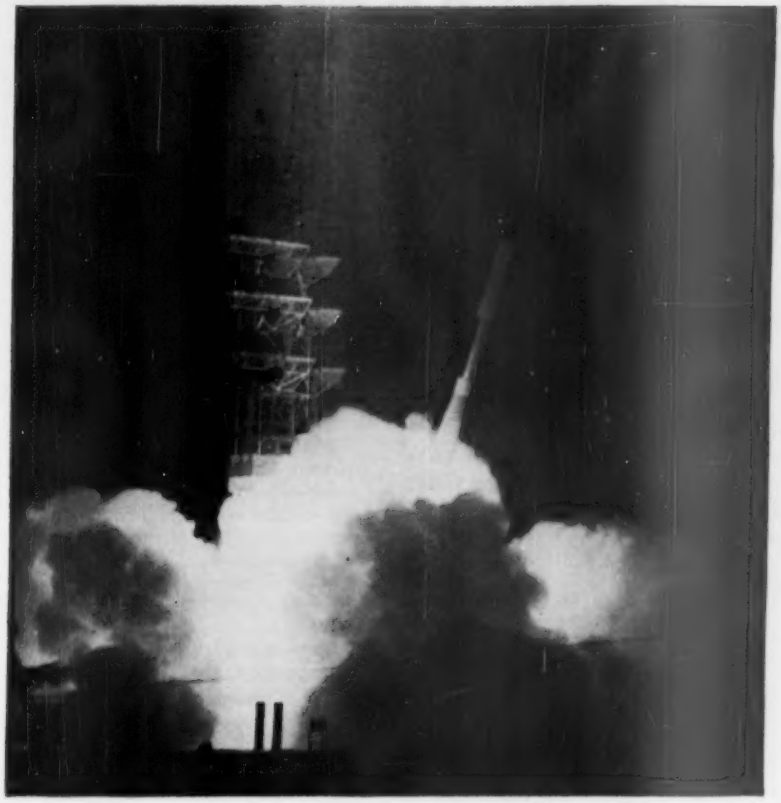
NASA also is evaluating bids received from 11 companies for a smaller plasma arcjet engine, developing about 1/100 lb. of thrust, for use with the Sunflower I solar power system (AW Apr. 18, p. 30). In another competition, the agency will choose a contractor from a dozen bidders to develop an ion engine with about the same thrust for use with Snap 8.

Avco and General Electric will split the $500,000 NASA plans to spend for the year-long investigation of 30 kw. plasma arcjet engines. NASA Administrator T. Keith Glennan said the two companies were picked from the group of eight companies bidding because their proposals offered "promising and different" approaches to the problems involved.

NASA said one of the basic differences between the competitive Avco and General Electric approaches lies in the engine-cooling arrangement.

The agency will negotiate contracts with the two companies calling for a one year research program which includes building and operating breadboard models of the engine. Decision on developing a flight prototype will be made after the research program is completed.

Principle of the plasma arcjet engine system involves passing a propellant gas like liquid hydrogen through an electric arc, according to NASA. Gas is heated to 4,000 deg. before it escapes through a nozzle, producing thrust. Development of electrodes capable of operating reliably for two months or longer is termed a major problem.



NASA SCOUT was recently launched to test performance of first and third stages of the 72-ft. vehicle. Scout is first satellite launcher to use solid fuel rockets exclusively. Vehicle fell in the Atlantic about 80 mi. from shore after attaining 30 mi. altitude.

Space Technology

Ignition Failure in Third Stage Aborts Initial Scout Test Launch

Washington—First flight test of Scout launch vehicle components aborted last week when the vehicle's third stage motor failed to ignite during a flight from National Aeronautics and Space Administration's Wallops Station, Va.

Scout first stage engine carried the test vehicle to an altitude of about 30 mi., but it fell far short of the expected 100 mi. altitude when the third stage engine apparently failed to fire. The 72 ft., 35,000 lb. vehicle carried a dummy second stage and a weighted nose cap to simulate the fourth stage.

Test vehicle made an unguided ballistic flight stabilized by the fins on its first stage. Test flight was made to check operation of the first and third stage motors and operation of launch tower. It also provided the ground crew with experience in Scout countdown and launch procedures.

First stage in the test vehicle was the Aerojet-General Algol solid propellant motor, which develops 100,000 lb. thrust. Second stage was an inert version of the Thiokol Castor. This motor, which develops 50,000 lb. thrust, already has been flight tested in the Little Joe booster.

Flight was to have provided vibration and environmental test of the Hercules-Allegany Ballistics Laboratory X-254 Antares third stage. This motor develops 10,000 lb. thrust and is a scaled up version of the Hercules-ABL X-248 which has been used on a number of launch vehicles. Scout's Altair fourth stage motor is an X-248.

Third stage motor was scheduled to ignite when the test vehicle had coasted for about 45 sec. after first stage burnout. Ignition would have taken place at an altitude of about 30 mi., but telemetry indicated there was no third stage ignition, and the vehicle fell in the Atlantic about 80 mi. from shore.

News Digest

Project Echo inflatable passive communications satellite is now scheduled to be launched from Cape Canaveral, Fla., on May 5. National Aeronautics and Space Administration announced the date to permit volunteers to prepare to bounce radio signals from the 100-ft. sphere. Inclination to the orbital plane will be about 48 deg. from the equator and orbit about 1,000 mi. Third stage of the Thor-Delta launching vehicle will carry a radio that is expected to transmit on 108.96 mc. for 8 to 10 days. Satellite is expected to be in direct sunlight for about two weeks.

Burt C. Monesmith has been named to the new position of corporate vice president-manufacturing by Lockheed Aircraft Corp. He will report to D. J. Haughton, executive vice president. M. Carl Haddon, who has been vice president and general manager of the Electronics and Avionics Division, will replace Monesmith as vice president and general manager of the California Division.

Raymond G. Largent, 57, secretary and controller of Cessna Aircraft Co., died in Wichita on Apr. 14 after a long illness. Largent joined Cessna as an auditor in 1941, was named chief accountant in 1951 and elected secretary of the firm in 1952.

Second test version of the Army-Martin Pershing tactical missile was successfully fired last week from the Air Force Missile Test Center, Cape Canaveral, Fla., to verify first-stage motor performance and the vehicle's aerodynamic characteristics. Only the first stage was fired. Second stage was weighted and a dummy nose cone was used.

Thomas V. Jones, president of Northrop Corp., was named the company's chief executive officer last week in addition to being president. Previous chief executive officer was Chairman of the Board William McDuffie. Jones was named company president in May, 1959.

Packard Bell Electronics Corp. has received a $600,000 contract from Navy Bureau of Weapons for airborne recorder-computer systems for anti-submarine warfare equipment.

Aeronca Manufacturing Corp. will produce brazed stainless steel honeycomb structures for the B-70 Mach 3 bomber under a North American contract. Aeronca had an earlier B-70 contract which was terminated.

Electra Safety Dispute Splits FAA, CAB

Durfee letter asks grounding of Lockheed transport, widens breach between agencies, sparks Senate debate.

By L. L. Doty

Washington—Sharp rift between the Civil Aeronautics Board and Federal Aviation Agency grew wider last week as a bitter controversy over whether the Lockheed Electra turboprop transport should be grounded was thrown onto the Senate floor for public debate.

Latest clash between the two agencies, one of several that have been brewing since the Board lost its safety rule-making authority to the FAA (AW Aug. 18, 1958, p. 38), was sparked by a letter dated Apr. 12 from Board Chairman James Durfee to FAA Administrator E. R. Quesada. The letter recommended grounding of all Lockheed Electras which have not yet undergone the special comprehensive inspections now being conducted by operators of the 135 Electras in domestic scheduled service.

The letter drew strong resentment from FAA officials on the grounds that the recommendations were based upon findings of which the FAA already was aware and which disclosed no structural defects on the aircraft. A new row was touched off last week when Sen. Vance Hartke (D.-Ind.) demanded on the Senate floor that Quesada explain publicly his reasons for refusing to follow the Board's advice.

Here are the events which led to the battle that many observers feel may have far-reaching effects on future public acceptance of the Electra:

• **Electras were placed under** operating speed restrictions by the FAA following the disintegration of a Northwest Airlines Electra near Tell City, Ind. on Mar. 17 (AW Mar. 28, p. 40). Because of a marked similarity between the circumstances of that accident and the unsolved disintegration of a Braniff Airways' Electra near Buffalo, Tex., on Sept. 29 (AW Oct. 5, p. 28), FAA imposed the new cruising speed limitation of 225 kt. pending the results of CAB's investigation of both accidents.

• **FAA promptly launched** an intensive inspection and flight and static test program conducted jointly by FAA, Lockheed and the National Aeronautics and Space Administration. Although, as of late last week, causes of the two accidents still remained a mystery, Quesada said that ". . . nothing has been revealed to date which would warrant the grounding of the fleet."

• **U.S. carriers were instructed** by the FAA to conduct a special inspection program on all Electra fleets and report their findings to a central bureau established by the FAA at Burbank, Calif. Inspections on all Electras in operation have been completed.

• **A CAB employe at Burbank** telephoned the Board on Apr. 11 to say that carrier inspections disclosed deficient wing tabs on some Electras. There are 1,450 tabs on each Electra. The tabs, which are installed to secure the skin surface of the wings to the ribs, are considered defective if one of the approximately six rivets in each of the small tabs becomes loosened. FAA technicians and airline aerodynamic engineers agree that such a situation does not constitute a structural defect and, therefore, is no justifiable reason for grounding the Electra.

• **Board Chairman Durfee,** prompted by the information received from the employe, sent a two-page letter to Quesada urging the grounding of the airplane.

Aggravation of FAA people at the recommendation was capped by a final paragraph in the letter which urged that the FAA lift any punitive action against pilots who make hard landings with the Electra until all investigations on the aircraft had been completed. The Board reasoned that pilots may be failing to report such hard landings in order to avoid possible punitive action.

It was this recommendation that brought FAA officials to a boiling point and may have created an irrevocable breach between the two agencies. As one member of the FAA said, "no experienced pilot would shirk his responsibility of reporting a hard landing even if he did face punitive action."

He added that determination of steps to be taken following a hard landing rest with the airline unless structural

First Convair 600 Moves Down Production Line

First Convair 600 turbojet transport moves down production line at San Diego plant. Center section of the fuselage has been mated to the wing box, which is identical in dimensions with the 880, but is of heavier structure to support increased wing area. Powered by General Electric CJ-805-23 aft fan engines, the 600 has same wingspan as the 880 but is 10 ft. longer. Aircraft will have maximum cruise speed of 635 mph. First flight is scheduled for late September. American Airlines, Swissair and SAS have placed orders for the 600.

damage results and pointed out that the FAA has never taken any action against any pilot for making a hard landing.

Throughout the debate, Quesada has stood firm in his position that analyses and studies conducted thus far reveal no reasons for grounding the airplane. He said:

"Unless future inspections or additional investigations on the Electra reveal the need to revise our program, the series of safety measures imposed by the Federal Aviation Agency on Mar. 25 shall continue to be in effect. These measures were originally ordered to provide the necessary margin of safety essential to the operation of this aircraft. Nothing that we have learned since these orders were originally issued leads us at this time to believe that they are not wholly adequate."

Quesada drew the strong support of Sen. Stuart Symington (D.-Mo.) who praised FAA in the Senate saying:

"I desire to keep this discussion on the highest plane, but must say that, whoever is the head person in the CAB, I am not impressed with the attempt to take potshots at the FAA action, because the latter people have made a real effort to ascertain the cause of this problem."

Meanwhile, Sen. Warren Magnuson (D.-Wash.), chairman of the Senate Commerce Committee, indicated he will support a congressional hearing on the controversy but added that any such hearing probably will not be held until studies and investigations provide more tangible evidence of Electra structural problems. Congressional investigation would probably be chaired by Sen. A. S. Mike Monroney (D.-Okla.), head of Commerce Subcommittee on Aviation.

In his charges against FAA, Hartke admitted that much of the information on which he based his protests stemmed from "grapevine" and "unofficial sources." He accused Quesada of "unjustified secrecy," noting that the FAA head had delayed his reply for "several hours" after Hartke had released "the facts as I knew them. . . ."

FAA has taken the position that there is no "secrecy" involved because, thus far, there is nothing to tell. Agency members emphasize that, if the Board has exaggerated the seriousness of the wing tab problem, the public would certainly also react similarly. In addition, the agency firmly holds that the deficient wing tabs are not an issue at stake with respect to the airworthiness of the airplane and that the Board's stand on this point has created a sensational controversy out of proportion.

Meanwhile, here is the status of the FAA Electra inspection program:

• **All defects reported** by carriers are being collated in the centralized Burbank bureau operated by FAA to determine whether such reported defects set a pattern. So far, there have been no indications that such defects follow a defined trend. All defects found have been minor.

• **Lockheed is currently** flying an Electra on the West Coast instrumented to measure forces applied to individual structural members of the aircraft and its powerplants under turbulent atmospheric conditions. No conclusive findings have resulted from these tests yet.

• **Electra, borrowed from** Northwest Airlines (AW Mar. 28, p. 40), is undergoing static testing. Aircraft is being mechanically shaken to check wing deflection rates and structural stiffness. Tests are still in process.

• **Electra wing and an engine** is being subjected to a series of static tests scheduled to culminate in their complete destruction.

• **Allison Division** of General Motors is conducting new flight tests with an Electra owned by the manufacturer.

• **FAA inspectors are focusing** attention on preflight inspections, flight planning and operating procedures of the carriers.

ICAO Council Approves DME For International Use With VOR

Montreal—International Civil Aviation Organization Council has voted to adopt Tacan-compatible distance measuring equipment (DME) as an international standard for use with VOR (omnirange) and to assure the use of both until at least 1975. DME was supported by 14 countries in the 21-member ICAO council, providing the two-thirds minimum vote under which a navigation standard can be adopted.

The action all but ends the long and bitter controversy which had its beginnings in the early postwar years when the British sought to have Decca adopted as the international navigation standard.

Unless a majority of the 77 member states of ICAO file notice of disapproval of the action before Sept. 1, it will become effective on Jan. 1.

Following the ICAO Council vote last week, the representative from Australia, which had opposed DME's adoption, stated that his government would accept the decision and provide VOR and DME for use by international carriers. However, Australia would not install them for domestic service, he said. The United Kingdom representative made no statement on his government's intended action.

The ICAO Council generally adopted the recommendations made a month earlier by the agency's Air Navigation Council (AW Mar. 21, p. 44). It voted unanimously to adopt VOR as an international standard for en route use. VOR already had been an international standard for terminal area use.

For applications of DME to other than VOR installation, such as using it with an instrument landing system in a terminal area, the council adopted Tacan-compatible DME as a recommended practice, as distinguished from a mandatory international standard.

In the most controversial question, over whether Tacan-compatible DME should be adopted as an international standard, the following countries voted for its adoption: Argentina, Brazil, Japan, Philippines, Spain, Venezuela, United States, United Arab Republic, Portugal, Netherlands, Lebanon, Italy, Guatemala and Germany. Countries which did not vote for DME included: Australia, Denmark, France, South Africa, United Kingdom, India and Canada.

New Transport Marks Claimed by Soviets

Moscow—Soviet Union is claiming several speed records for its Tu-114 turboprop transport with loads never attempted before in international competition.

Latest Tu-114 claim involves a flight over a 3,105 mi. (5,000 km.) Moscow-Sverdlovsk-Sevastopol-Moscow course with a 25 metric ton load. Average speed for the flight was 544.7 mph. Russia also is claiming records for the 1, 2, 5, 10, 15 and 20 ton payload classes for the same flight. An American Boeing B-29 set a record for 10 tons over this distance in 1946.

Earlier, the Tu-114 was reported to have flown a 25 metric ton payload 1,243 mi. (2,000 km.) at an average speed of over 532 mph. Soviets also claim speed records for all the lower weight classes for this flight, topping a record for 15 tons over this distance previously set by the Russian Il-18. In a 621 mi. (1,000 km.) flight, the Tu-114 flew 25 metric tons at an average speed of 541.4 mph.

Russians have used a Tu-104E to claim a record set by a U. S. KC-135 tanker when it carried 10 tons 1,243 mi. at 589 mph. Soviet turbojet transport flew 15 metric tons over the 1,243 mi. distance at 596.12 mph. Records were claimed for 1, 2, 5, 10 and 15 ton classes. Tu-104E is a modified Tu-104 with "more powerful and more economical engines," according to Sovetskaya Rossiya.

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CAB Orders Major Capital Plight Probe

By L. L. Doty

Washington—The Civil Aeronautics Board last week launched a major investigation of Capital Airlines to determine whether the debt-ridden carrier should stay in business.

In an order issued late last week, the Board called for a hearing to look into the reasons for Capital's current crisis and to determine whether any or all of the airline's certificates of public convenience and necessity should be amended, modified or suspended. The Board also will consider whether any or all of the company's routes should be transferred to other carriers or whether they should be integrated into the routes of another airline through a merger.

The decision was issued while the regular meeting of the carrier's Board was in session here. This meeting resulted in no substantial changes in management structure. All officers were re-elected, although George Hann, chairman of the Board, stepped down without being replaced. A 10% cut in officers' pay was voted and three directors, including President David Baker, were named to visit Vickers-Armstrongs in London as soon as possible in hopes that some solution to the carrier's current financial plight could be worked out.

Capital's Position

Earlier, Baker had told a stockholders' meeting that Capital's position was critical, that only an immediate subsidy could save the company from its current precarious position and that a merger would be the best long-range solution to its over-all problems. The CAB order followed by 24 hr. the stockholders' meeting in which Baker charged that "Capital's route structure is a creature of the CAB . . ." adding that "the CAB must accept its share for the carrier's unprofitability."

During the company's annual meeting here, which spanned several hours of heated protests against management and its board of directors from vocal stockholders, Baker explained the series of events that have brought the airline near the brink of financial disaster (AW Apr. 18, p. 38). He said the short-haul nature of the carrier's routes, lack of competitive flight equipment, severe weather in its operating regions this winter and failure of the Civil Aeronautics Board to improve fare structures are the basic causes behind Capital's critical condition.

The meeting followed by three days a petition in a U. S. district court by Vickers-Armstrongs, Ltd., manufacturer of the Viscount turboprop transport operated by Capital, to foreclose on all the company's flight equipment and to appoint a receiver to take charge and conserve the carrier's flight equipment.

The action, which involves a suit for $33.8 million against Capital, stems from a Vickers' demand for payment of all outstanding notes following the airline's failure to pay past due accounts totaling $11.9 million when called. The notes are secured by chattel mortgages which provide that, if outstanding balances are not paid on demand, Vickers "shall be entitled to recovery judgment therefor . . . together with costs, which shall include the reasonable expenses of Vickers and its agents and attorneys . . ."

Here is a summary of the action Vickers requested the court to take in its petition:

- **An accounting of all amounts** due Vickers plus interest on the notes and all costs and charges incurred in connection with the suit and other efforts to realize payment.
- **Capital should be ordered** by the court to pay Vickers the total amount found to be due the British manufacturer.
- **Appointment of receiver** to take over Capital's property subject to the lien of the mortgage and, in the event payment ordered by the court is defaulted, all such property be sold under the direction of the court. If proceeds from the sale do not sufficiently cover payments due, Vickers asked that it be granted a "decree for the amount of such deficiency against Capital."

Prior to the filing of the foreclosure petition, Capital's board of directors met in a seven hour-long emergency session in an attempt to work out a program that would avert the drastic action. However, no solution to the company's dilemma was found and no changes in the airline's basic management structure were made at about that time.

Meanwhile, the airline asked the Securities and Exchange Commission to withdraw a registration statement proposing an offering of 909,659 additional shares of common stock. The equity financing program was arranged in connection with a major refinancing plan (AW Feb. 1, p. 30) worked out earlier this year for the purchase of Convair 880 turbojet transports and Lockheed Electra turboprop transports. The over-all re-equipment program has since been dropped.

Baker had no firm solution to Capital's immediate "critical" problem other than to stress an urgent need for subsidy. He said that Capital's lack of profits was due in large part to the Board's route award policy which, he emphasized, has put Capital in competition with "the giants of the industry" on short-haul routes. He concluded that Capital's "only hope" now rests with the CAB.

Merger Decision

On the point of mergers, he made no mention of a specific airline that might be approached for merger but said three major factors would govern the airline in making a merger decision—how much average passenger haul would be lengthened by a merger, amount of expense reduction that could be accomplished through consolidation and the degree to which both companies would be strengthened.

He said that, when the airline was strong enough to weather its present crisis, it would seek such mergers and suggested that other regional carriers faced with a high degree of heavy competition may be forced to take similar action.

Baker said the Vickers loan costs will total $15 million in 1959 as compared with $13.2 million last year and $10.2 million in 1958. Total debt covering the purchase of the original fleet of 60 Viscounts was $68.1 million. Since 1955, when the notes were first signed, Capital has paid Vickers-Armstrongs a total of $34.2 million in principal and $10.8 million in interest.

In addition to the amounts paid on the notes, Capital also has paid "the British interests" $22.9 million for spare parts and related equipment. In all, the airline to date has paid the "British interests" a total of $67.9 million in five years.

Baker vigorously denied that there had been any "collusion" between Capital's petition for a $12.9 million subsidy request (AW Apr. 4, p. 17) and the Vickers foreclosure suit.

New CAB Chairman

Washington—President Eisenhower last week nominated Iowa Republican Whitney Gillilland to succeed James Durfee as chairman of the Civil Aeronautics Board.

Gillilland, a 56-year-old attorney, has been a Board member since November when he was named to fill the unexpired term of Harmar Denny. Early this year, the Senate confirmed him for a full six-year term.

His appointment followed Senate confirmation earlier in the week of Durfee as a judge of the Federal Court of Claims by a 69-15 vote.

At Los Angeles International Airport, old runway resurfaced with CONCRETE makes 150-ton jets feel right at home!

Los Angeles gets ready for jets. Photo shows modern equipment now placing new concrete directly on the old flexible pavement of runway 25L. They're paving 1,600 feet of 25-ft. strips every working day, will take just 120 days for the whole 150-ft. x 6,150-ft. runway! *Artist's sketch at top of page shows how airport will look with modern concrete runways and new futuristic-styled terminal area.*

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MATS' Needs Outlined in Big Slam Report

By Robert H. Cook

Washington—Value of the Military Air Transport Service training program and its need for more modern aircraft were cited by MATS last week as major lessons learned from the recent Big Slam-Puerto Pines airlift exercise (AW Apr. 4, p. 50).

Emphasizing the success of the experiment before a House Armed Service special subcommittee on national airlift, Army and Air Force spokesmen praised the inter-service cooperation during the lift and recommended that such exercises be increased and carried out on a minimum-notice basis.

The U.S. Continental Army Command, however, was quick to make its needs for more airlift known and qualified its praise of Big Slam by pointing out that the 21,000-man task force participating in the airlift was "not a balanced Army force" in that it failed to provide the proper ratio of combat and support troops.

Maj. Gen. Ben Harrell told the subcommittee the MATS airlift handled 11,000 tons of cargo for the troops but would have been required to carry 27,626 tons to support a balanced force of similar size.

Time Factor

Had a balanced force been moved, Gen. Harrell said, MATS would have been required to fly an additional 300 sorties beyond the 942 actually flown. The added flights would be needed primarily to transport equipment and supplies, thus creating a need for more cargo aircraft, he said. Gen. Harrell estimated that airlifting a balanced force would have increased the airlift time from 12 to 16 days.

The Army spokesman said the proper time factor for transporting forces could not be evaluated in Big Slam in terms of what would be required for an actual assault and, at the same time, emphasized the importance of reducing the transportation time involved.

Gen. Harrell added that, while the Army considered Big Slam a training exercise, any further airlift exercises should be conducted with balanced forces and with a minimum of notification.

Lt. Gen. William H. Tunner, commander of MATS, concurred with the Army's views on conducting airlift exercises on shorter notice and pointed out that while the 447 MATS aircraft were successful in meeting their wartime required utilization rates, it was made possible "to a marked degree" by the amount of advance planning that went into Big Slam. He also warned:

"However, the present resources of MATS in personnel and material exercised at the five hours flying rate for the bulk of the force may not be sufficient to meet the wartime utilization requirements under a condition of negligible or no strategic warning. This is the condition we must expect and plan for in an emergency."

Gen. Tunner said Big Slam "validated" MATS contentions that it needs a five hour daily utilization rate to maintain its capability of accomplishing wartime tasks.

He said that, while MATS can plan and execute large scale air movements of troops with other military commands, the obsolescence of its present aircraft fleet "seriously limits" the size of Strategic Army Corps forces that can be airlifted to overseas points in the periods of time desired by the Army.

He pointed out that U.S. war plans dictate "immediate need" for more efficient aircraft to carry out these short-time, long-distance deployment missions and suggested that swing tail versions of existing Douglas DC-8, Boeing KC-135, Boeing 707, or Convair 600 aircraft would solve MATS' initial aircraft needs within 18 to 12 months.

"Of course," he added, "I must say quickly that the aircraft I mentioned are probably not the only aircraft that would do the job."

While MATS' obsolete aircraft were equal to the tasks assigned during Big Slam, Gen. Tunner said modernization of the MATS fleet to include both interim aircraft and specific Operational Requirement aircraft would permit his command to bypass island bases in the Atlantic, saving hundreds of miles on a round trip across the Pacific. He estimated that MATS could then deploy an effective Army airborne division, plus the required Tactical Air Command composite air strike force, in one third of the time now required.

Gen. Tunner also called for more large-scale airlift exercises to more distant overseas bases on "at least" an annual basis and more frequently if funds permit. Smaller operations also should be planned and executed, he said.

CRAF Role

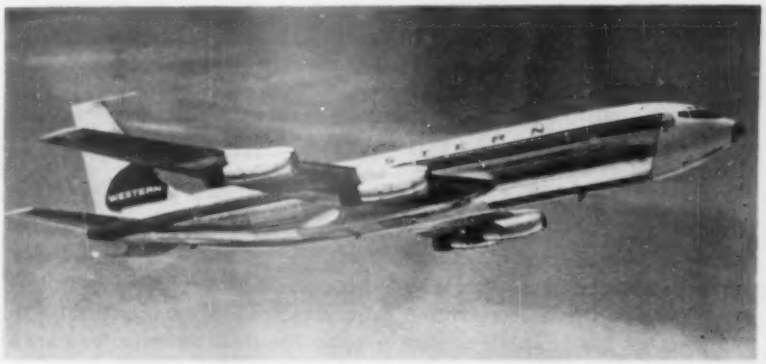
The proper role of the Civil Reserve Air Fleet in time of war or national emergency also was discussed by Gen. Tunner, who told the subcommittee that civil airlines were not included in the Big Slam exercise because only a ready military force could be counted upon to carry out assignments to any "potentially hot" combat zones. CRAF must be confined to the quietest zones in augmenting MATS in wartime, he said.

Gen. Tunner also reiterated his stand that, since it is a civil contract arrangement and does not guarantee the response that might be needed, the entire CRAF complement of men and equipment must be made subject to military control and discipline equal to the military.

Gen. Tunner also answered critics of the MATS five-hour daily utilization rate and said that many of those who have advocated that the rate be dropped to as low as one hour "either do not understand the complexities of our big military job or they choose to ignore them."

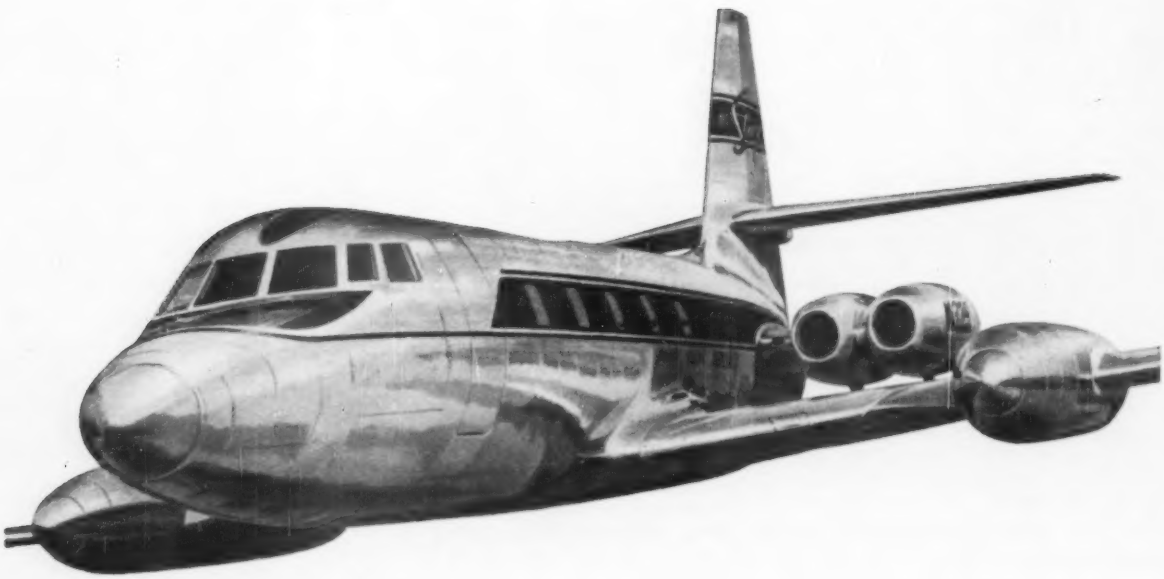
Key to the five-hour rate, he said, is the sustained high utilization rate required by the Joint Chiefs of Staff war plan and the present limited resources available to MATS. He added:

"People learn by doing. . . . The work force either becomes competent to accomplish the five-hour peacetime rate



Western Schedules Pacific Coast Jet Service

Western Air Lines will schedule its first Boeing 707-120, powered by Pratt & Whitney JT3C-6 turbojets, between Los Angeles, San Francisco-Oakland, Portland and Seattle-Tacoma starting June 1. Configuration will be 46 de luxe and 71 tourist seats.



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or the objective is not attained. If the five-hour daily utilization objective for the bulk of the MATS force is routinely accomplished, the surge achieved during the exercise becomes primarily a product of additional work hours applied."

Noting that MATS logged more than 50,000 hr. of flying in Big Slam without a fatality, although the aircraft experienced some severe weather conditions, the MATS commander said "no artificial training system could ensure the air crew and ground crew experience to guarantee the safest possible airlift of young American fighting men."

Airlines File Salaries, Bonuses With Civil Aeronautics Board

Washington—Following is a list of airline officers' salaries, bonuses and indirect compensations, expenses and stock holdings for the year ending Dec. 31, 1959, as filed with the Civil Aeronautics Board:

Trunk Airlines

Braniff Airways, Inc.—C. E. Beard, president, $72,000 salary, $5,265 bonus and indirect compensation, $6,526 expenses and 21,600 shares of common stock; **J. W. Miller**, executive vice president, $46,000 salary, no bonus or indirect compensation, $1,385 expenses and 1,206 shares of common stock; **C. G. Adams**, vice president-finance and secretary, $33,000 salary, no bonus or indirect compensation, $1,553 expenses and 6,759 shares of common stock; **R. C. Shrader**, vice president, $18,000 salary, $1,215 bonus and indirect compensation, $61 expenses and 1,200 shares of common stock; **R. V. Carleton**, vice president-operations, $36,900 salary, $2,633 bonus and indirect compensation, $895 expenses and 4,000 shares of common stock.

R. Brack, vice president-traffic and sales, $28,500 salary, $2,003 bonus and indirect compensation, $3,739 expenses and 300 shares of common stock; **M. Harrison**, vice president-industrial relations, $23,000 salary, $1,590 bonus and indirect compensation, $451 expenses and no stock; **W. Henshel**, vice president-public relations, $21,500 salary, $1,478 bonus and indirect compensation, $1,178 expenses and no stock; **V. A. Kropff**, assistant vice president-executive projects, $13,200 salary, $855 bonus and indirect compensation, $1,824 expenses and no stock; **O. W. Crane**, treasurer, $15,450 salary, $1,024 bonus and indirect compensation, $491 expenses and 213 shares of common stock; **R. L. Barrier**, assistant treasurer and budget director, $12,450 salary, $799 bonus and indirect compensation, $134 expenses and no stock.

F. J. Beisecker, assistant treasurer, $12,450 salary, $799 bonus and indirect compensation, $64 expenses and no stock; **L. Eden**, assistant treasurer, $12,450 salary, $799 bonus and indirect compensation, $319 expenses and no stock; **V. Bowlware**, assistant secretary, $5,100 salary, $248 bonus and indirect compensation, no expenses or stock; **T. Robertson**, assistant vice president-research and statistics, $11,700 salary, $743 bonus and indirect compensation, $1,553 expenses and no stock; **H. Bolding**, vice president-purchasing and stores, $17,250 salary, $1,159 bonus and indirect compensation, $218 expenses and 4 shares of common stock.

C. S. South, vice president, $20,000 salary, $1,365 bonus and indirect compensation, $6,428 expenses and no stock; **F. Jones**, director, no salary, $600 bonus and indirect compensation, no expenses and 2,132 shares of common stock; **G. Butler**, director, no salary, $400 bonus and indirect compensation, no expenses and 10,720 shares of common stock; **R. J. Whiteford**, director, no salary, $400 bonus and indirect compensation, no expenses and 1,120 shares of common stock; **W. A. Blakley**, director, no salary, $600 bonus and indirect compensation, no expenses and 517,955 shares of common stock; **T. N. Law**, director, no salary, $600 bonus and indirect compensation, no expenses and 130 shares of common stock.

G. D. Murdoch, no salary, $400 bonus and indirect compensation, no expenses and 1,400 shares of common stock; **W. W. Flenniken**, director, no salary, $600 bonus and indirect compensation, no expenses and 339 shares of common stock; **M. McGreevy**, director, no salary, $600 bonus and indirect compensation, no expenses and 3,000 shares of common stock; **A. Shivers**, director, no salary, $400 bonus and indirect compensation, no expenses and 1,000 shares of common stock; **J. H. Walker**, director, no salary, $600 bonus and indirect compensation, no expenses and 2,100 shares of common stock.

Following firms were paid for services rendered during 1959: **Whiteford, Hart, Carmody & Wilson**, legal $72,000; **Ernst & Ernst**, audit, $8,400.

Capital Airlines, Inc.—D. H. Baker, president and director, $60,000 salary, no bonus or indirect compensation, $4,616 expenses and 300 shares of common stock; **R. G. Lochiel**, senior vice president, treasurer and director, $34,499.94 salary, no bonus and indirect compensation, $2,504 expenses and 4,000 shares of common stock; **W. H. Johnson, Jr.**, senior vice president and director, $14,000.08 salary, no bonus and indirect compensation, $2,957 expenses and 100 shares of common stock; **J. B. Franklin**, senior vice president, $30,699.96 salary, no bonus and indirect compensation, $1,677 expenses, 850 shares of common stock and $64,000 worth of debet securities.

M. Whitlock, senior vice president, $19,712.17 salary, no bonus and indirect compensation, $1,678 expenses and no stock; **R. J. Wilson**, vice president, $26,218.80 salary, no bonus and indirect compensation, $3,734 expenses and 198 shares of common stock; **H. Dever**, vice president, $20,712.42 salary, no bonus or indirect compensation, $3,914 expenses and 1,900 shares of common stock; **B. Q. Chalfant**, vice president, $17,500.08 salary, no bonus or indirect compensation, $3,204 expenses and 103 shares of common stock; **G. W. Hobbs**, vice president, $22,500 salary, no bonus or indirect compensation, $2,952 expenses and no stock; **J. H. Mahoney**, vice president, $4,999.90 salary, no bonus, indirect compensation, expenses or stock; **R. W. Hardesty**, vice president, $19,556.08 salary, no bonus or indirect compensation, $904 expenses and 100 shares of common stock.

S. T. McAlister, assistant vice president, $15,650 salary, no bonus or indirect compensation, $1,309.60 expenses and no stock; **A. H. Norling**, assistant vice president, $16,330.08 salary, no bonus or indirect compensation, $1,322.57 expenses and no stock; **S. B. Goldthorpe**, assistant vice president and comptroller, $16,041.74 salary, no bonus or indirect compensation, $951.90 expenses and no stock; **A. Gould**, assistant vice president, $14,000.36 salary, no bonus or indirect compensation, $1,917.72 expenses, 36 shares of common stock and $15,000 worth of debet securities; **E. Raymond**, assistant vice president, $15,397 salary, no bonus or indirect compensation, $627.63 expenses and no stock; **W. B. Smith**, assistant secretary, $10,537.50 salary, no bonus or indirect compensation, $395.39 expenses and no stock; **R. P. Wright**, assistant treasurer, $16,200 salary, no bonus or indirect compensation, $146.04 expenses and 300 shares of common stock; **O. F. Estes**, assistant treasurer, $15,000 salary, no bonus or indirect compensation, $707.16 expenses and no stock.

Following directors were not paid a salary or expenses: **W. V. Couchman**, $1,100 bonus and indirect compensation, 200 shares of common stock and $2,000 worth of debt securities; **J. F. Cullman**, $700 bonus and indirect compensation, no stock; **D. L. Frawley**, $1,200 bonus and indirect compensation and 2,000 shares of common stock; **G. R. Hann**, $1,400 bonus and indirect compensation and 45,832 shares of common stock; **C. T. Johnson, Jr.** $600 bonus and indirect compensation and 265 shares of common stock.

A. F. Kroeger, $2,000 bonus and indirect compensation and 559 shares of common stock; **C. B. Monro**, $1,300 bonus and indirect compensation and 152 shares of common stock; **C. H. Murchison**, no bonus and indirect compensation with 80,532 shares of common stock; **J. R. Stockton**, $1,100 bonus and indirect compensation and 4,310 shares of common stock.

Following firms were paid for services rendered during 1959: **Charles Butler Associates**, design services, $11,517; **Arthur Anderson**, management consultant, $10,504; **Council for Economic and Industrial Research**, computer service, $17,677; **Lippincott & Margoulis**, corporate image study, $16,548; **Lybrand, Ross Bros. & Montgomery**, management consultants and tax and audit, $42,816; **J. H. Carmichael**, management consultant, $17,500; **Adair, Murchison, Kent & Ashby**, legal counsel, $178,718; **Kenyon & Eckhardt**, advertising services, $2,310,061; **Art Designers**, advertising art, $55,680; **Colortone Press**, advertising art, $30,112; **Globe International Detective**, guard service, $41,872; **Manufacturers Trust**, transfer agent, $11,110; **Wessenaar, Holland, Wallance & Clark**, facilities planning, $30,754; **Chase Manhattan Bank**, registrar and pension trustee, $11,680.

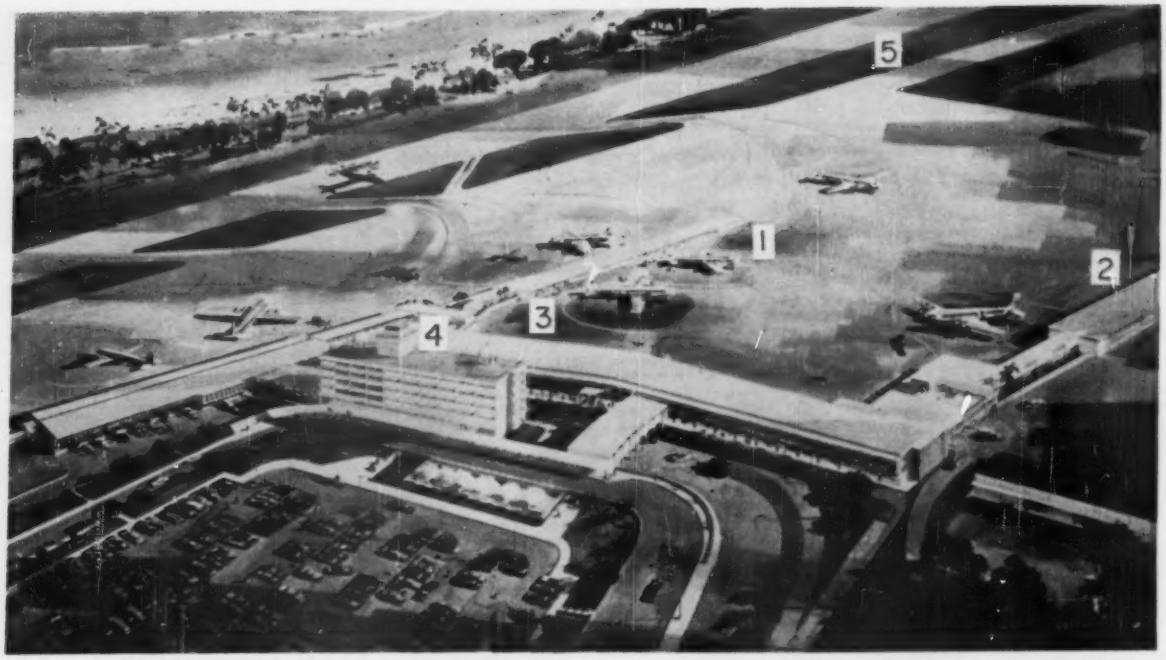
American Reports First Quarter Loss

Washington—American Airlines last week reported a net loss of $453,000 for the quarter ending Mar. 31, which included a net gain after taxes of $464,000 from the sale of property.

American President C. R. Smith said the loss was incurred despite a substantial increase in gross revenues, adding that "airline fares are too low and they should be promptly increased. . . ." In a speech here last week, Smith said there are too many airlines on some routes and that such a large number of carriers "cannot be continued if the airlines are to operate with a profit and avoid a return to federal subsidy."

Smith called upon business and government to encourage "some re-arrangement of routes and services. . . ." Postponement of such action "can only weaken an industry that should remain strong," he said.

In another financial report, Pan American World Airways said last week that it recorded a net profit of $7.7 million for the year 1959. Operating revenues of $356.8 million represented a 14% increase over last year. Expenses for 1959 showed an 11% increase.



ARCHITECT'S SKETCH shows details of $7 million expansion program now under way at San Juan International Airport. Construction will include two fingers extending east from main terminal (1 and 2); second story for south wing of terminal (3); recessed radar deck for control tower (4); and 1,600-ft. extension for airport's east-west runway (5).

San Juan Airport Expansion Under Way

By David H. Hoffman

San Juan—Seven years ago, engineers planning San Juan International Airport forecast that 980,000 passengers would emplane or deplane at the ocean-side terminal by 1965. In 1958 their estimate was prematurely exceeded as 1,001,728 passengers traveled to or from Puerto Rico's capital via 11 scheduled airlines.

The total reached last year was 1,300,679—29% greater than the previous year. Next month the airport will celebrate its fifth birthday on the eve of a $7-million construction program forced by the unexpectedly high volume of passenger traffic.

To keep pace with this growth rate, consistently double that of the average U.S. airport, the Puerto Rico Ports Authority plans to expand San Juan International in stages, with construction scheduled to start this summer on two 680 ft. fingers linking the main terminal building with aircraft on the ramp.

These parallel walkways will serve 17 new loading stations, each with hydrant fueling, giving the airport a total of 27 loading points. The paved parking area surrounding them will be correspondingly increased.

By next January, San Juan's 7,800-ft. east-west runway will be lengthened to 9,400 ft. As soon as this concrete sets, a second round of construction will extend it to 10,500 ft. along piers of earth sunk in shallow Caribbean inlets on each end of the runway.

Overwater approaches will minimize ground engine noise and will not discourage builders who would add to the line of luxury hotels that reaches from San Juan city, 5 mi. to the west, almost to the airport.

Meanwhile, the south wing of the terminal will be double-decked and a seventh story, housing ASR-4 surveillance radar, will be added to the tower.

Area Increased

Over-all expansion will increase the operational area of the terminal from 200,000 sq. ft. to 460,000 sq. ft.

In the tower's recessed radar deck, controllers will offer visual separation to planes 150 mi. before they converge on Puerto Rico's 5 kw. homing beacon from all points of the compass.

Of the project's $7 million total cost, $2.3 million will be furnished by the Federal Aviation Agency, all of it earmarked for terminal building construction. In addition, FAA will underwrite 50% of runway extension costs, leaving a balance of about $4 million which the Ports Authority will raise through bond sales.

The heightened interest of Americans in the Caribbean as a vacation center—an interest that has been focused on Puerto Rico by outbreaks of anti-American feeling within Dr. Fidel Castro's Cuban government—also underlies San Juan's new prominence as an air traffic hub.

During December, January (the month in which Dr. Castro assumed power) and February of 1958-59, 291,522 passengers moved through San Juan International. The comparable figure for the peak Puerto Rican tourist season of 1959-60 was 343,700, or an increase of 52,178.

The master plan that will guide San Juan International's expansion through the next decade is based upon a maximum passenger flow of 4.9 million, to be reached during the 1970 calendar year. But O. L. Sands, chief of the aviation division of the Ports Authority for six years, explains that even this estimate is misleading because of Puerto Rico's airport "visiting ratio."

In continental United States, according to Sands, each arriving or departing passenger at an airport will attract one visitor, resulting in a ratio of one to one. In Puerto Rico, however, this ratio is five to one, so that a terminal handling 4.9 million annual passengers also must be able to accommodate 24.5 million annual visitors.

Last year, more than 750,000 of these visitors paid the Ports Authority $75,000 to watch aircraft movements from the observation deck of San Juan

International. (Those short enough to pass under the airport turnstiles were admitted free and hence not counted.)

By comparison, the observation deck of La Guardia Airport, the nation's fifth busiest, was host to 417,000 paying spectators during 1959, earning only $41,700 for the Port of New York Authority.

Ranked by the number of passengers originating there in 1959, San Juan International is slightly larger than the Greater Cincinnati Airport, which is topped in turn by 20 other U.S. terminals. But growth and geography have made flight operations at San Juan somewhat more complicated than at Cincinnati.

Tower operators and Air Route Traffic Control officers here often direct the aircraft of 10 or more countries at the same time. The pilots of lightplanes, used extensively to connect Puerto Rico with nearby islands, are sometimes unfamiliar with Air Route Traffic Control regulations.

The flight plans forwarded by many South American stations are transmitted over CW (continuous wave) and received in dots and dashes at San Juan. Jet transports inbound from Venezuela, Jamaica or the Dominican Republic frequently make their appearance in San Juan's traffic pattern before their flight plans have reached Puerto Rico.

FAA Warns Pan American Of Possible Jet Violation Fine

Washington—The Federal Aviation Agency last week warned Pan American World Airways it is liable to a $2,000 fine in civil penalties on charges of faulty maintenance and inspection procedures on a Boeing 707 turbojet transport. The FAA action was the 18th safety violation acted upon by the agency thus far this year.

Under its existing authority, FAA cannot actually levy fines. It advises alleged violators that they are subject to civil penalties carrying a specific fine. The carrier, or airmen, can then voluntarily pay the fine or face possible court action. However the agency can, and often does, accept compromise payments from violators as a practical method of reprimand, while avoiding the cost and publicity of legal prosecution, according to FAA spokesmen.

In the case of Pan American, the agency said it will not make any offer to accept a compromise on the fine, because of the seriousness of the violation, which forced the pilot to jettison fuel and return to New York on an eastbound Paris flight on Jan. 16. After takeoff, the crew found that the altimeters, airspeed and rate of climb indicators were inoperative or operating erratically.

Cause of the trouble was later traced to the right and left forward fuselage static ports which were found sealed with electrical tape that had been applied during an earlier pressure check of the altimeter system.

Flight engineer Gail M. Engle, of Hicksville, N. Y., was suspended for 15 days for failing to discover the taped ports during preflight inspection, while the mechanic certificate of E. P. Irmscher, of North Babylon, N. Y., was suspended for 27 days, effective May 2.

Electrical mechanic William Hardy, of Amityville, N. Y., was warned by FAA that he could face a civil penalty of $1,000, but, since Pan American had previously suspended him for a two-week period, the agency agreed to a compromise acceptance of only $150.

Of the 18 alleged violations acted upon thus far this year, nine involve airlines, including domestic and international carriers and three foreign lines.

In another recent action, FAA revoked the pilot certificates of three American citizens charged with violating several sections of the Federal Aviation Act while dealing with anti-Castro revolutionaries.

Pilots Grounded

Pilot certificates of Howard L. Rundquist and William J. Shergallis, of Miami, were revoked under emergency procedures by FAA on charges that the two men flew to Cuba from Broward, Fla., County Airport without filing a flight plan or passenger manifest with the U.S. Immigration and Naturalization Service. FAA said the two men violated other agency regulations by penetrating both the Atlantic Coastal and Gulf of Mexico Air Defense Identification Zones and by carrying "explosive materials" in the form of 10 extra gallons of gasoline stored in cans. Since FAA was unable to determine which of the two men had piloted the aircraft, the agency voted to revoke the airline transport rating of Shergallis and the airman's certificate of Rundquist.

In a similar case, FAA has moved to revoke the airman certificate of Frank A. Fiorini, of Miami, on charges that he had purposely had a modified B-25 bomber registered in his name to permit its use by anti-Castro forces.

FAA, however, points out that the vast majority of violations are unintentional and, in the case of airlines, are generally corrected long before enforcement proceedings are deemed necessary by the agency.

However, in cases where the operator has failed to heed enforcement warnings, the agency can revoke or refuse to renew the carrier's operating authority. FAA says that it intends to reject a renewal application for American International Airways, a contract air carrier of Sherman Oaks, Calif., because it contends that the line has committed a series of violations, including failure to keep adequate aircraft maintenance or operating records, employment of airmen without required FAA instrument or equipment checks and maintenance of incomplete and inaccurate airmen records.

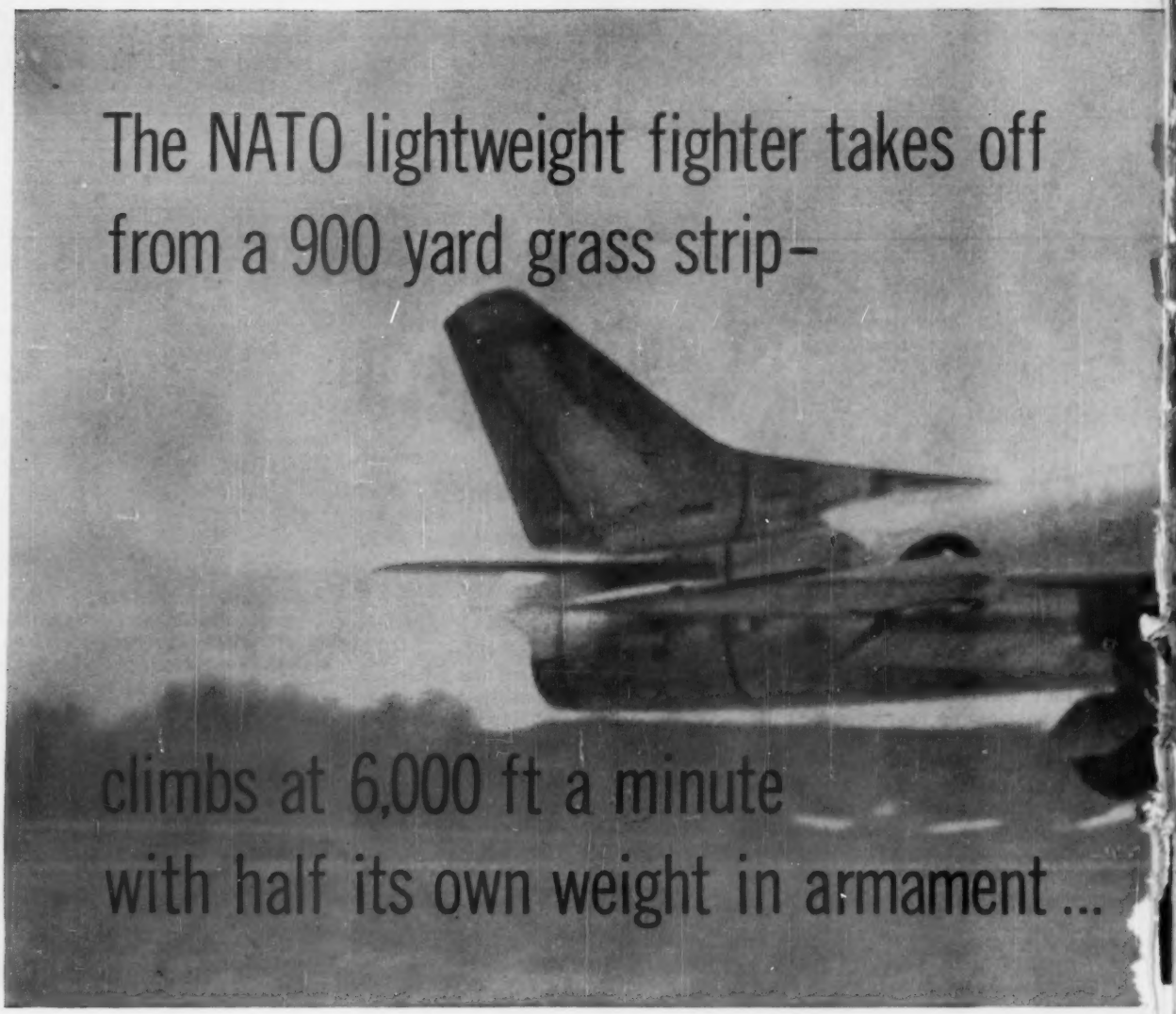
In other cases thus far this year, FAA has issued fine warnings and suspended pilot certificates on several occasions.

The captain of a Capital Airlines aircraft was suspended for 120 days effective Apr. 1 on charges that he took off without tower permission on Jan. 3 from Tampa, Fla. The agency said its investigation revealed that, although Tampa weather minimums called for a 100-ft. ceiling and quarter of a mile visibility for takeoff, the pilot ignored tower instructions and took off under zero-zero conditions.

Both the pilot and copilot of a National Airlines Convair 440 that landed 100 ft. short of the runway at Norfolk, Va., last June, received a retroactive 90-day suspension from duty, while a Mohawk Airlines pilot who made a wheels up landing at White Plains, N. Y., last September was reprimanded with a 57-day suspension, said FAA.

The pilot of a Central Air Transport aircraft was ruled subject to a $1,000 fine for exceeding FAA regulations for aloft and one-time duty last November, but was permitted to settle his case for a $50 compromise fine.

FAA enforcement officers are still investigating the case of two Capital Airlines' pilots accused by the company of violating both the airline's rules and FAA safety regulations by trading duties last Mar. 23 on a northbound Viscount flight from Miami. Capt. C. O. MacNeal of Detroit was discharged and Capt. R. M. J. Roddy of Pittsburgh was given a 30-day suspension. Roddy also will be demoted to the rank of copilot for a six-month period, according to company spokesmen. Violations occurred, Capital charges, when Roddy landed at Pittsburgh and turned command of the aircraft over to MacNeal for the flight to Buffalo without company permission. The airline says Roddy's action also violated FAA regulations because MacNeal was not fully qualified to serve as command pilot of a Viscount.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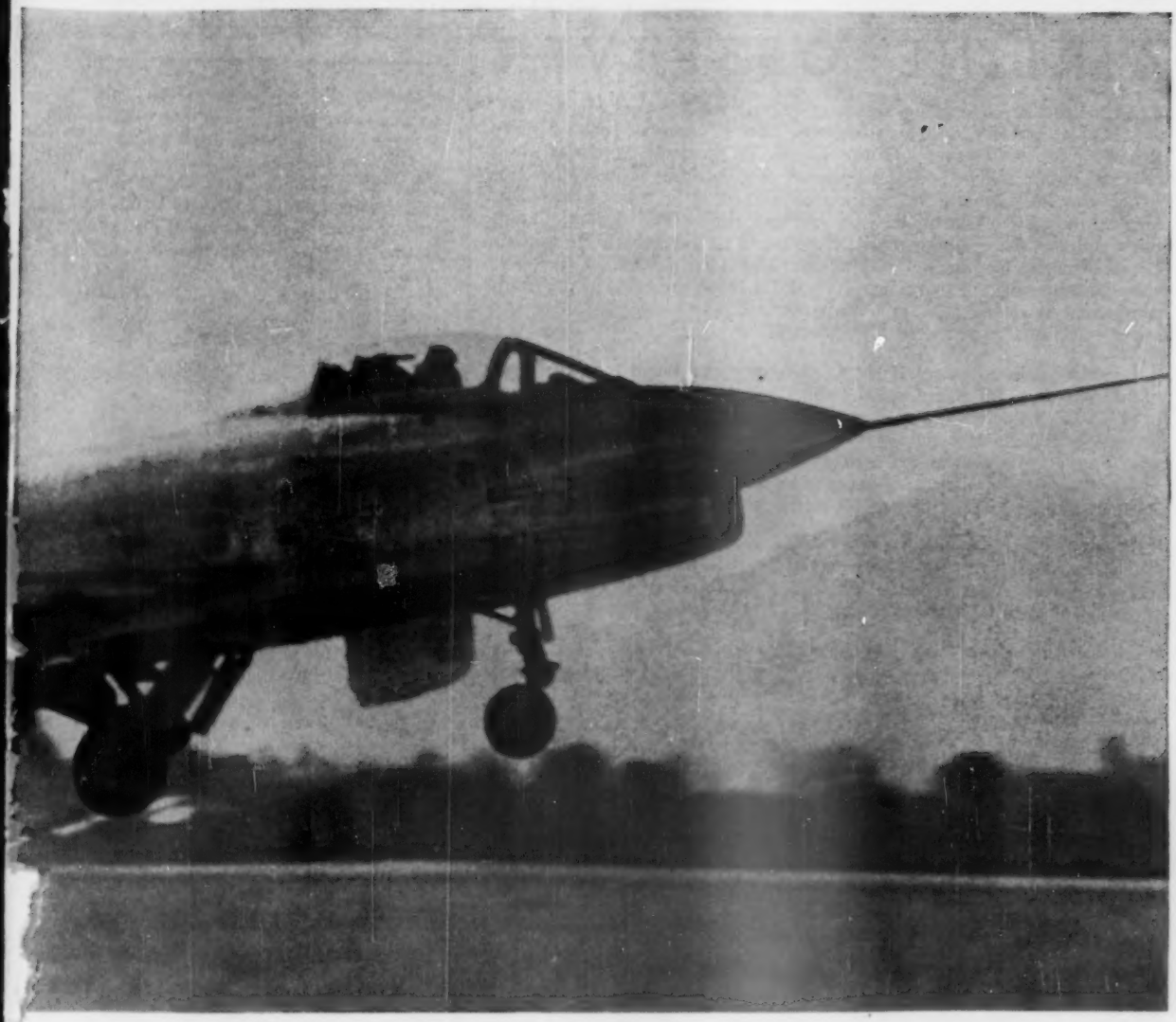

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AIRLINE OBSERVER

► Decline of 1% in trunkline revenue passenger miles during March (AW Apr. 18, p. 38) is not an accurate reflection of industry traffic activity generally. Severe weather and the impact of accidents, given as basic causes of the traffic drop, were predominant in regions east of the Mississippi River. Eastern, Capital, National and Northeast, with major routes confined to the eastern half of the U. S., suffered sharp traffic declines during the month. In this grouping, only Delta showed an increase. Three western carriers—Braniff, Continental and Western—recorded substantial increases, with Continental leading the industry with an 86% increase. Three transcontinental carriers—American, Northwest and TWA—reported moderate increases. United experienced a 9% decline.

► **American Airlines has asked the Civil Aeronautics Board for permission to intervene in hearings on Capital Airlines' request for subsidy (AW Apr. 4, p. 47). In its petition, American charged that the industry would be harmed by the grant of subsidy to Capital and added: "Such action . . . would project the government into unnecessary and unsound competition with self-supporting airlines, thereby undermining the industry's economic integrity and adversely affecting its future health and growth."**

► Japan Air Lines has signed a contract for the purchase of three Convair 880-M transports to be powered with General Electric CJ-805-3B turbojet engines. Carrier will use the aircraft on its Southeast Asia flights and its projected route to Europe (AW Mar. 28, p. 41).

► **Capital Airlines has fully implemented a new industrial vacation plan whereby employes of major industries may purchase vacation packages through a wage-deduction plan. Under the program, employes select a vacation package offered by Capital and then authorize payroll deductions so that all travel and other expenses have been fully paid when the vacations begin. The airline already has contracted with eight major firms to introduce the plan to their employes.**

► Aeroflot's first scheduled nonstop Il-18 flight between Moscow and Cairo early this month covered the route in 6 hr. 50 min. The four-turboprop Soviet transports will fly three Moscow-Cairo trips per week.

► **Hawaiian Airlines is considering the purchase of a third Douglas DC-6B to supplement its fleet of Convair 340s in inter-island operations this summer. The airline recently purchased a ninth Convair—a 440—from KLM to permit an increase in the inter-island schedules.**

► Federal Aviation Agency has awarded a $5.9 million contract to Mitre Corp. to conduct advanced experimentation on a semi-automatic air traffic control system using current air defense SAGE facilities.

► **Pressure is increasing in large metropolitan areas for the introduction of scheduled helicopter service. Last week, Georgia Helicopter Airlines applied to the Civil Aeronautics Board for routes to serve communities in the Atlanta area with Sikorsky S-58 helicopters. At least seven applications for helicopter routes in the San Francisco area are pending before the Board. Two organizations can be expected to seek operating rights in Washington, D. C. Scheduled helicopter service is now available in New York, Chicago, Los Angeles and St. Louis (AW Feb. 22, p. 104).**

► Civil Aeronautics Board is scheduled to hold a public hearing May 3 in Richmond, Va., on the Capital Airlines Vickers Viscount accident near Charles City, Va., Jan. 18.

► **One of the landmarks of Times Square in New York—TWA's one-half scale Lockheed Constellation model complete with revolving propellers—is being phased out. It won't be replaced with jet equipment. Contract for the billboard space, overlooking the square at 43rd Street, and jointly paid for by TWA and Lockheed, ran for five years and is terminating as jets take over a major role in the airline's operation. High cost of the space is one important reason for decision not to put a new model in its place, though absence of propellers on jet aircraft as an attention-getting device may also have figured in the choice.**

SHORTLINES

► **Aeroflot**, the Soviet state-owned airline, is now using four-engine An-10 turboprop transports on cargo flights to supply Russian Arctic scientific stations on drifting ice floes. Soviet officials say each An-10 can carry as much payload as six piston-engine Il-14s. Effective cargo arrangement and the truckbed-level fuselage enabled one An-10 to unload eight and one-half metric tons of supplies in 15 min. at one ice floe station, according to Aeroflot.

► **Civil Aeronautics Board** has ordered an investigation into reduction in cargo rates proposed by Eastern Air Lines, Pan American World Airways and Trans Caribbean Airways on the New York-San Juan route. Average reductions would be about 20%, but some rates would be trimmed by as much as 30%. Riddle Airlines, in a complaint to CAB, charged that the new rates are below operating costs and "constitute an attempt to put the carrier [Riddle] out of business."

► **De Havilland Aircraft Co.** reports that a Royal Air Force order for five Comet 4C turbojet transports may be signed within the next three months. RAF, which has been discussing a 4C purchase with de Havilland for the past two years, has had the shorter-range Mk. 2 version of the Comet in service for some time.

► **Federal Aviation Agency** has opened a new experimental air traffic control Remington Rand Univac File-1 computer laboratory at its Atlantic City, N. J., test center. The new laboratory will test operational concepts for improved traffic control and improvements for the automatic computers already installed at Indianapolis, New York, Washington, Pittsburgh, Cleveland and Boston.

► **Military Air Transport Service** last week announced the award of civil airline contracts totaling $279,708.92 to Los Angeles Air Services, Overseas National Airways, Twentieth Century Airlines and Alaska Airlines. Carriers are to fly 3,200 military passengers during April and May to Alaskan and Pacific areas.

► **Olympic Airways** has increased its order for de Havilland Comet 4B turbojet transports from three to four, with first delivery of the original order scheduled for May. The additional Comet 4B is now scheduled to be delivered sometime this fall.

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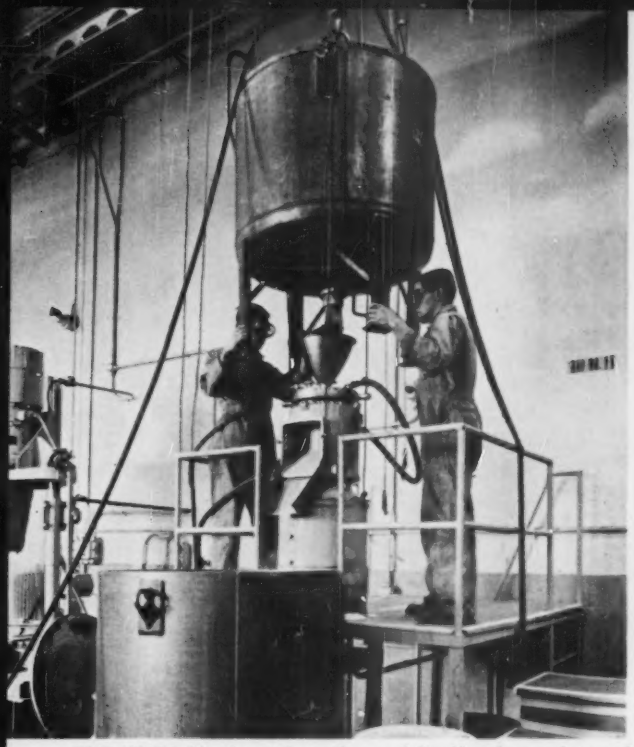
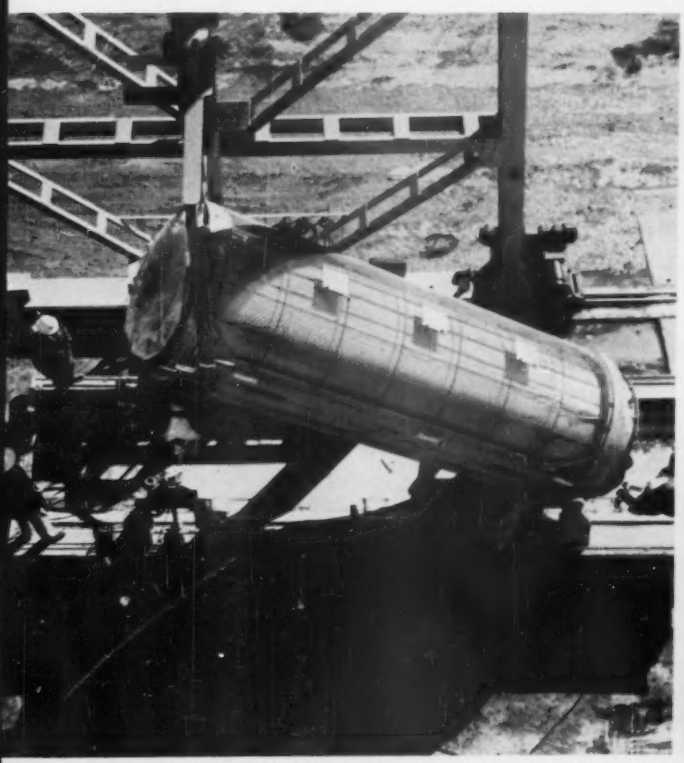


OPERATORS blend metal powders and liquid polymers into a fuel slurry in pre-mix operation (left). Slurry is discharged through funnel-shaped colloid mill to ensure dispersion of solid particles. Liquid pre-mix can goes to area at right where workers will sift it by remote control into oxidizer they have just finished grinding to make a 4,300-lb. batch of propellant.

Minuteman First-Stage Moves Toward



TRAVELING BRIDGE CRANE running on rails over the pits on the casting line lifts the first-stage casing from the transporter. Lifting bar is attached to one of the two sets of trunnions on casing's handling harness. As the bar is raised, the casing rotates about the pair of trunnions on the other end to reach a vertical position. It then is lifted clear of the transporter.

TECHNICIAN prepares to discharge propellant from the mixer into a batch transfer can located under the floor grill in front of the mixer (left). Prior to transferring the propellant cans to the casting house, the large, first-stage Minuteman engine casing (right) is moved to the loading pits on Thiokol's in-plant transporter.

Production

By Michael Yaffee

Brigham City, Utah—Minuteman first-stage rocket engine program, which now has several successful static firings to its credit, will soon move from research and development into the production phase at Thiokol Chemical Corp.'s facility here.

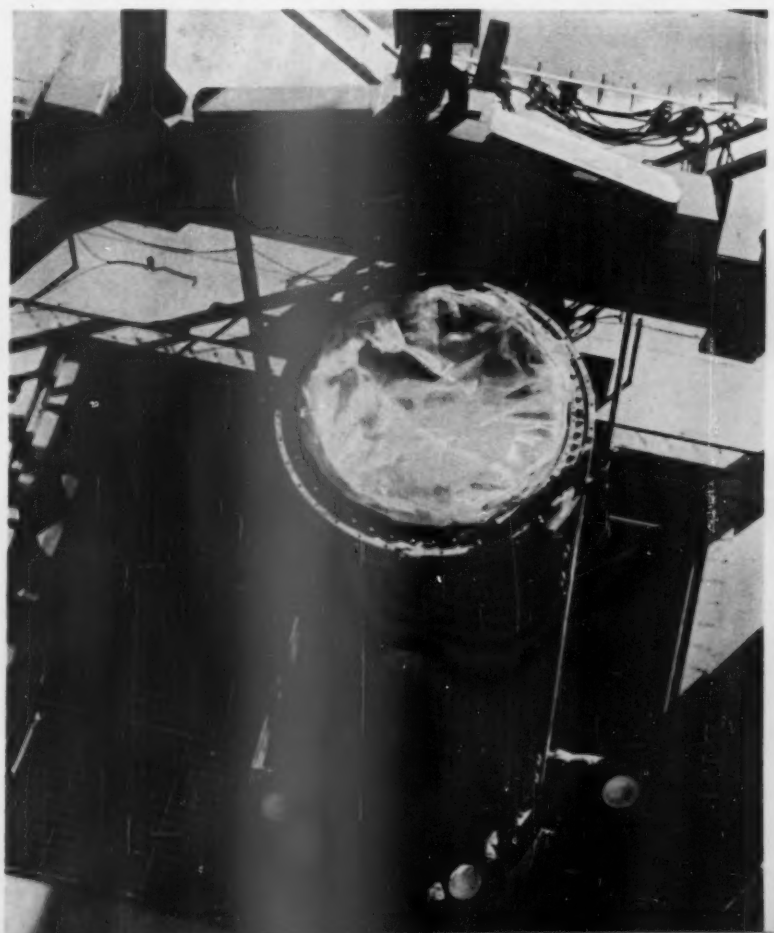
With it will go new techniques and equipment developed during the research and development phase for processing the first stage, the largest solid propellant rocket engine to go into production in this or possibly any other country.

Plans for the first phase of the production shift are already being put into effect here. These plans cover everything from construction of a new production unit, to be known as Plant 78, to the reconstruction of rural Utah roadways. In all, Thiokol plans to invest $2½ million in construction of the new Minuteman production facility and the Air Force is expected to invest another $30 million.

The company already has established a Utah Production Division. The next step, which is expected shortly, will be the award of the architectural and engineering contract for the new unit.

Plant 78 will be located adjacent to the company's 11,000-acre site at northeast tip of Great Salt Lake, where Thiokol has been carrying out research

FIRST-STAGE casing is guided by workmen down into a casting and curing pit. The pits are large enough to permit technicians to move on catwalks down around the casing. At the top left of the pit are the return (hot) air ducts.



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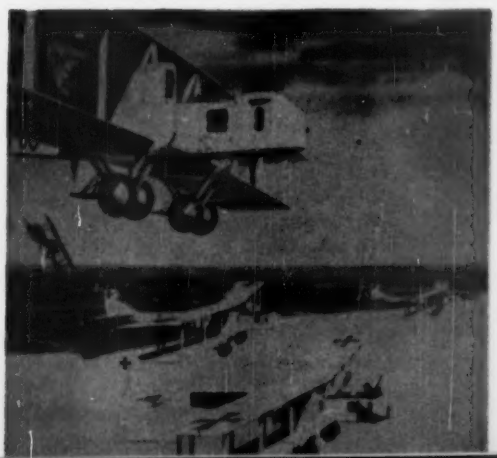
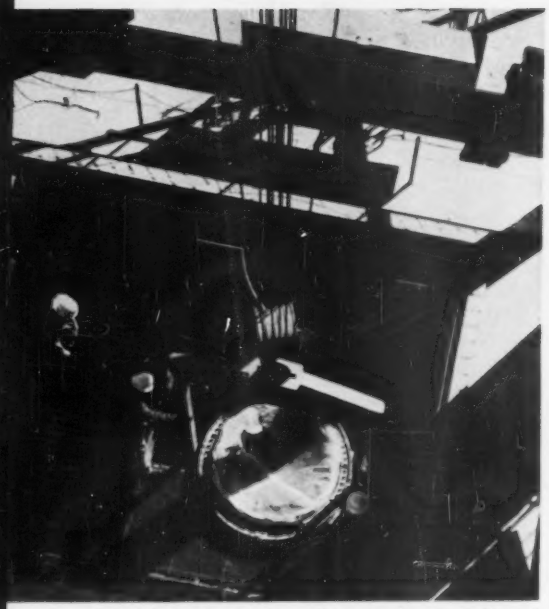
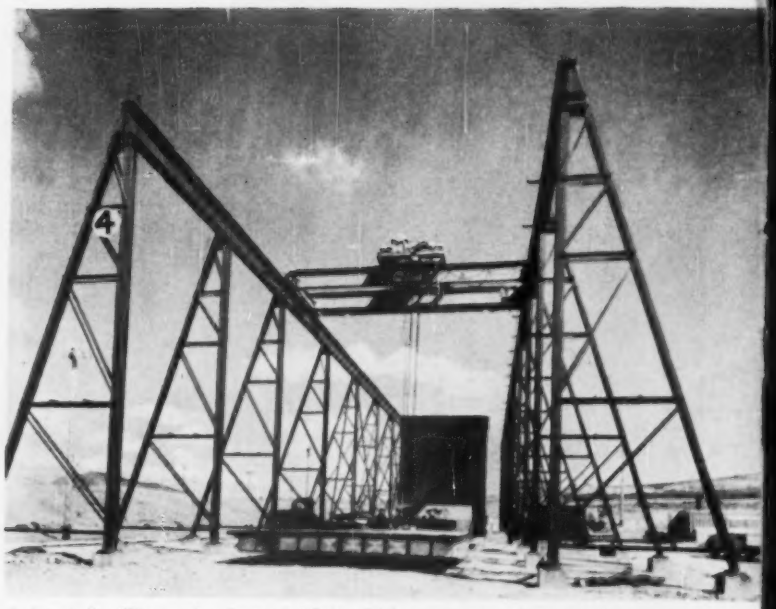






CASING is placed into position in the pit (left) and core is inserted. The casting house (right), which is on rails, then is rolled over the pit. The propellant transfer cans are lifted into the casting house by the overhead crane (there is a roof opening for the cables), pressurized and the propellant is fed through bayonets into the top of the casing.

TRANSRECTOR, which is used to aid in in-plant handling, can lift, transport and set up the Minuteman first-stage engine at any point in the plant, from casting pit to the firing bay or railhead. Transrector can be used over a pit or a missile silo.

and development on the Minuteman first-stage engine, as prime contractor, and on the second stage, as backup, as well as producing solid propellant boosters for the Martin Matador and Boeing Bomarc missiles.

Designed specifically for large solid propellant rocket engines, Thiokol's new complex here has been built from the beginning for the integrated handling of large solid propellant motors, from the mixing of raw materials to the static firing or delivery of finished engines. Nobody will say exactly what equipment or capabilities Plant 78 will add to the existing facility but some strong possibilities are Thiokol's new continuous mix operation, additional loading and assembly pits, more environmentally conditioned storage area, and additional static test stands. In any event, the new production facilities will be integrated into the existing complex along with a continuing development program aimed at phasing improvements into the Minuteman system.

Perhaps the most unusual aspect of the Minuteman program here, other than the newness and expanse of the facility, is the processing concept of making many of the operations mobile and bringing them to the rocket rather than the reverse.

Thiokol's new continuous-mix operation, a portable version of which already has been developed, would fit right into this concept as well as into the closely related one of on-site loading (AW July 28, 1958, p. 43).

The large size of the Minuteman first-stage rocket engine necessitated

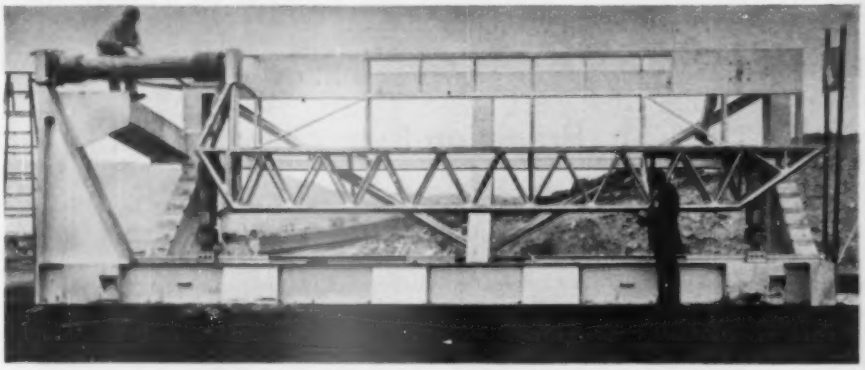
THREE of the five casting and curing pits on the Thiokol line are shown in view (left) from an overhead crane. After curing, finishing and assembling, the first-stage engine is lifted from the pit onto a transporter and moved to storage. Conditioning box on the transporter at right, which is for the smaller second-stage, usually is placed over the loaded engine in inclement weather.

the development of this new processing concept, says Thiokol. To continue the conventional approach of moving the engine from one point and one operation to another could have led to prohibitively high program costs.

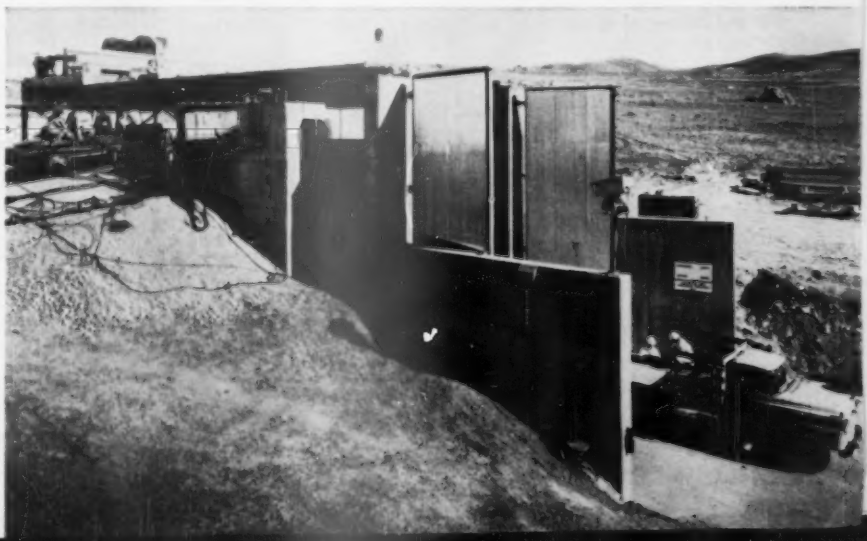
The heart of the operation here is the multipurpose casting pit. In addition to casting, it serves for curing, finishing and final assembly of the complete rocket engine. First, the casing and mandrel are brought to the pit. An overhead crane lifts the casing from the transporter and lowers it into the pit. The mandrel is inserted, and the casting house, which is on rails, is rolled over the top of the pit. The propellant, which is mixed in another area, is now brought to the casting house in batch cans and pressure-fed through a bayonet loader into the top of the casing.

Propellant Curing

The propellant is cured in place for a number of days. While this is going on, more engines can be placed in the other pits. In all, there are five large pits in the one line served by the casting house. A second line is now under construction. After the grain is cured the core is removed, excess propellant is trimmed off, end closures and sometimes even the nozzles are attached—all in the pit. The finished engine is then hoisted out of the pit and trucked to an environmentally-controlled storage facility. From here it goes to a static firing test bay or, eventually, out of the plant and down the road about 50 mi. to Hill AFB near Ogden where Boeing will assemble the Minuteman ICBMs.



MULTI-COMPONENT, million-lb. static thrust stand (above), shown before installation, is designed to measure side thrust of vectored nozzles as well as total, centerline thrust. Crane on top of the firing bay (below) lifts the engine from its transporter for vertical firings. For horizontal firings, the engine rolls on rails off the transport and onto the static test stand.



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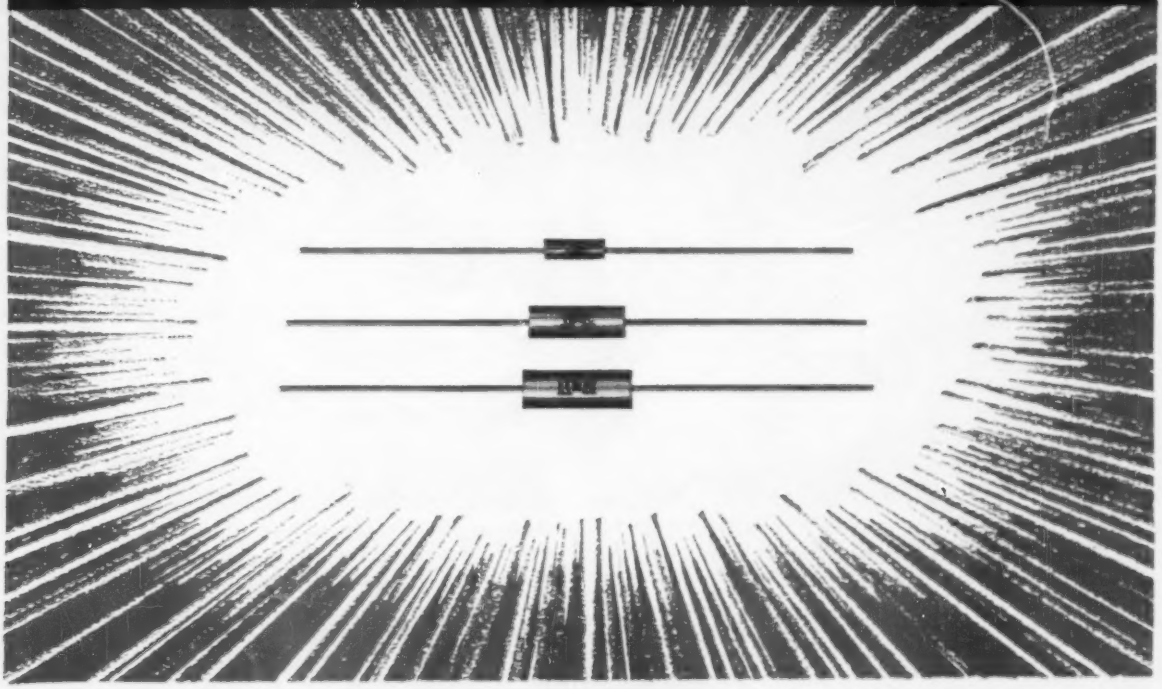

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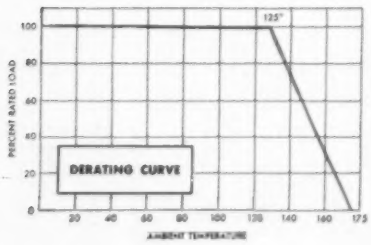
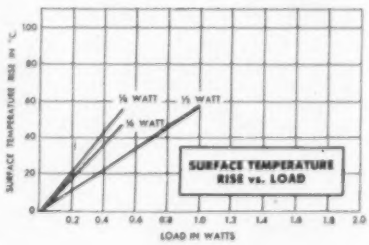
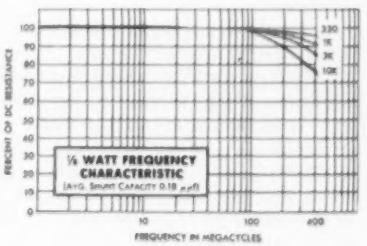
IRC Stabaloy resistors are available in 3 standard sizes—⅛ watt, ¼ watt and ½ watt. The illustrations above are actual size. Standard tolerance is ±1.0%. Tolerance of ±0.5% is available. For most of the advantages of precision film resistors at an economical price, examine carefully the characteristics of IRC Stabaloy resistors. Write for Bulletin AE-10. International Resistance Co., Dept. 202, 401 N. Broad St., Philadelphia 8, Pa.

*Registration pending.







IRC *Leading supplier to manufacturers of electronic equipment*

White Paper Details Administration Stand

(Defense Department, faced with increasing criticism of its policies, has drafted the first detailed statement on the Eisenhower Administration's stand on defense. The White Paper, issued in reply to questions posed by Carter Burgess, president of the American Machine & Foundry Co. and former assistant secretary of defense, was issued over the signature of Oliver M. Gale, special assistant to the Secretary of Defense. It also is being circulated by the Defense Department to approximately 600 leaders of American public opinion. Since it provides the most comprehensive insight to date on the Administration's position, and the thinking behind it, AVIATION WEEK *is publishing the paper in full. The paper emphasizes that it represents "the combined thinking of the Secretary of Defense and his principal military and scientific advisers." Later, however, Mr. Gale said he drafted the paper on his own initiative and put it in the mail "before any top officials in the Defense Department, including Secretary Gates . . . knew anything about it."*)

You have asked for a comprehensive statement regarding the strength of the nation's defenses, with particular reference to the current debate on the "missile gap" and the seven or eight other more specific questions that are being asked by some who are concerned about the defense program.

For more than a year now a few critics of the defense program have been successful to an almost incredible degree in confining discussion of our military strength to one single segment—the intercontinental ballistic missile. The concept that our security depends on our matching the Russians in numbers of these particular missiles—something with which our top military and scientific advisers disagree violently—has caused many thoughtful people to be concerned and even fearful and has made it difficult for the public to reach sound judgments regarding the state of our preparedness.

We propose to devote the body of this letter to a rather full statement of the thinking which underlies and determines the planning of our strategic nuclear deterrent forces for the present and the near future, and to answer your specific questions in attachments. These answers represent the combined thinking of the Secretary of Defense and his principal military and scientific advisers.

They have also been cleared by Security Review.

The first point to be understood is that a missile of the Atlas type may be the best weapon for the Soviets to place heaviest reliance upon today and for the next two years or so; it is definitely not the best for us. Let's look at the basis for this statement.

First, the Atlas is a soft target. The early ones can be put out of commission by a nuclear near-miss; even the later ones are in fixed positions well known to the Soviets, who can take whatever time they need to make sure their missiles are zeroed in on these sites. The Russians, on the other hand, with their highly effective Iron Curtain, make it difficult for us to have any assurance that we know the precise location of all their ICBM bases, thus giving themselves one of the best protections there is—concealment.

Secondly, we have stated as national policy that we are not going to initiate a surprise attack on another nation. This means our strategic forces will be used in response to an attack upon us. With planes, if we see in our warning radars something that looks like incoming hostile aircraft, we can get our retaliatory forces into the air where they are invulnerable to surprise attack and are ready for a strike against the enemy. But once we have sent missiles on their way, there is no recalling them. In other words, if our major reliance is on ballistic missiles, either we have to send them on their way before we are certain that we are being attacked or we have to wait until the bombs have landed upon us with the possibility that many of our retaliatory weapons will have been destroyed.

Oliver M. Gale, special assistant to Secretary of Defense Thomas S. Gates, Jr., first came to the Pentagon in 1957 with his employer at Procter & Gamble, Neil McElroy. Mr. Gale, who had served as manager of Procter & Gamble's department of public relations, remained in Washington when Mr. McElroy resigned as Secretary of Defense last fall to return to Procter & Gamble as chairman of the board.

Born in Ventura, Calif., on July 27, 1909, Mr. Gale attended the Choate preparatory school, received a bachelor of arts degree from Harvard College in 1931 and a master of arts degree from the Harvard Business School in 1937.

From 1931 to 1933 he taught at the Francis Parker School in Chicago and later served as a reporter and rewrite man on the Boston Herald. He joined Procter & Gamble's marketing department in 1937. In 1954, he served as a member of a U. S. technical assistance team to West Berlin.

For these and other reasons, heavy reliance on manned bombers at the present time makes a good deal more sense for the United States than does reliance on the intercontinental ballistic missile—whatever the situation may be for the Russians with their different resources, different geographical situation, different objectives and different problems.

By our current emphasis on the bomber, are we sacrificing military power or effectiveness, so that the advantages mentioned above are offset? On the contrary. A B-52 can deliver many times the explosive potential of the Atlas and with great accuracy and selectivity. A bomber can attack several successive targets. It is many times more reliable than a first generation ICBM. A bomber can be maintained at a high degree of alert—readiness to respond—with greater ease than the liquid-fuel ICBM. A bomber returns to report the success of its mission (which an ICBM does not), and it can be used for successive attacks.

It is true that defenses against the manned bomber have improved and may improve further. But so has the ability of the manned bomber to confuse and evade defenses. More important, the B-52 is being equipped with the Hound Dog missile which will enable the bomber to stand several hundred miles [illegible] target and fire ahead of it missiles many times as powerful as the first atomic bomb. When these have disorganized the defenses, the bomber can come in with considerably more impunity and perform its precise mission—still carrying a payload several times greater than that of the Atlas missile.

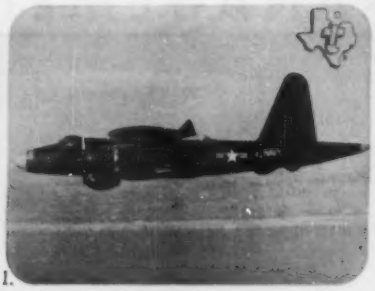
The intercontinental ballistic missile is a spectacular weapon and an extremely important one. But a nuclear weapon is equally lethal whether it is delivered by a ballistic missile or a bomber; and for us—at present and in the immediate future—the bomber is a far better delivery method.

The second point to be understood regarding our retaliatory position is that the variety and dispersion of our weapon systems are tremendous assets to this nation's defense; no estimate of our strength makes sense unless it recognizes this fact, and takes into consideration the whole of our strategic capability.

The nuclear deterrent forces of this country now include:

- **Over 2,000 long-range** strategic bombers—greatly out-numbering Soviet aircraft of comparable capability. This force is highly trained, completely equipped, and ready and maintained in varying stages of alert, including a large number on 15-min. ground alert, and a small number actually airborne at all times. Each of these bombers can deliver the destructive potential of several ICBMs, and with greater accuracy.
- **Two wings of tactical** bombers, each

TI IN MILITARY ELECTRONIC SYSTEMS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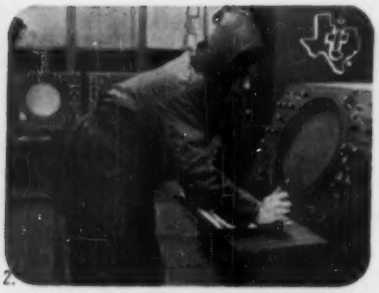
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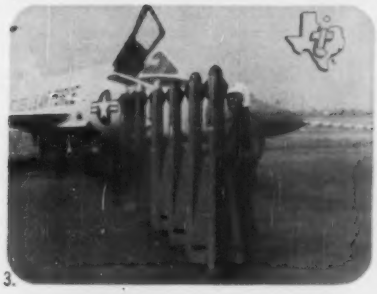
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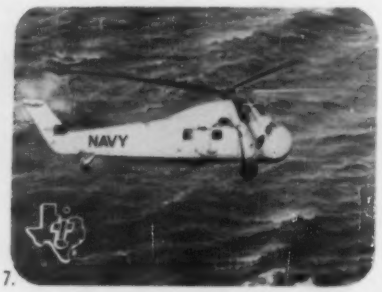

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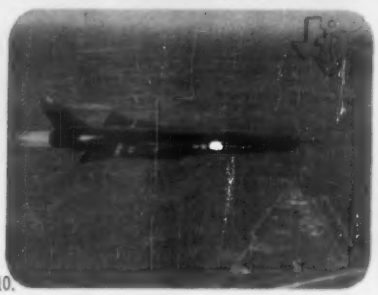
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A partial listing of equipment, designed, developed and manufactured by TI now operational in the Armed Forces includes:

1. AN/ASQ-8 magnetic anomaly detector, AN/AIC-15 intercom and TD-239A intervalometer for the U. S. Navy P2V ASW aircraft, built by Lockheed.

2. TARmac ASR-4 Airport Surveillance Radar for the Federal Aviation Agency.

3. Infrared optics for the U.S.A.F. FALCON Air-to-Air Missile, built by Hughes.

4. Anti-personnel Mine Detector AN/PRS-3 (XR-12) for the Corps of Engineers.

5. AN/APS-38A surface search radar, AN/ASQ-8 magnetic anomaly detector for the U. S. Navy S2F-1 ASW aircraft, built by Grumman.

6. Telemetry and guidance subsystems for the U. S. Navy CORVUS Air-to-Surface Missile, designed and produced by Temco.

7. AN/AQS-4 and AN/AQS-5 dipping sonar for the U. S. Navy HSS-1N ASW helicopter, built by Sikorsky.

8. AN/APS-80 surface search radar, AN/APA-125A radar indicator, AN/ASQ-8 magnetic anomaly detector and TD-239A intervalometer for the U. S. Navy P5M-2 ASW patrol seaplane, produced by Martin.

9. Programmers for the U.S.A.F. TITAN Intercontinental Ballistic Missile, built by Martin.

10. Surveillance sensors for the U. S. Army Signal Corps SWALLOW AN/USD-4 Combat Reconnaissance Drone, produced by Republic Aviation.

11. Surveillance sensors for the U. S. Army Signal Corps AN/USD-5 Combat Reconnaissance Drone, produced by Fairchild.

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with nuclear capability, deployed on many bases strategically located in advanced positions around the world.

• **Fourteen aircraft carriers,** several of which are deployed about the periphery of the Soviet Union. From these floating air bases, virtually invulnerable to ballistic missile attack because of their shifting positions, nuclear strikes can be made into almost any area of the Communist bloc. The aircraft in these carriers alone outnumber the heavy bombers in the Soviet Union, and they can carry weapons many times more powerful than the atomic bombs used in World War II.

• **Fourteen wings of nuclear-capable** tactical fighters, either deployed overseas or able to move there in a very few hours.

• **Operational Atlas missiles** ready for launching from the West Coast.

• **An operational squadron** equipped with Snark, a 5,500-mi. air-breathing missile with a very large warhead, difficult to pick up in defense radar.

• **Two cruisers and five submarines** equipped with the Regulus I, surface-to-surface weapon.

• **Four operational squadrons** equipped with a mix of Matador and Mace missiles, any one of which exceeds by far the total explosive power expended against all Axis military targets in Europe during World War II.

• **Intermediate range ballistic missiles**—the Thor—in the hands of the Allied Forces in the United Kingdom, each many times more powerful than the original atomic bombs.

No Deterrent Gap

This is why we say with assurance—there is no deterrent gap. How is it possible to ignore these forces? How can serious students of the defense situation set aside many thousands of megatons of nuclear potential, and limit their debate to a single weapons system, just because the Russians—void of overseas allies, lacking carriers, unable to reach us with intermediate range ballistic missiles or tactical weapons—have been forced, whether they chose it or not, to concentrate their energies primarily into a single channel in developing their strategic nuclear capability?

A third point to be understood with reference to our deterrent capability: as rapidly as missiles can be developed which are clearly superior to the first generation Atlas and Titan, and which meet the particular requirements of the United States strategically, we will add these to our impressive military forces. The Polaris, infinitely less vulnerable than the fixed base ICBMs, or the Minuteman, which can be placed on railroad cars for mobility, are examples.

If our security demanded it, we would of course have produced the Atlas in greater numbers. This country could have turned out almost any number it wished. Sound strategic reasoning led us to choose not to produce as many of these first-generation, fixed-site, liquid-fueled missiles as we estimated the Soviets could produce. If this course had left us without the needed deterrent, we could not have held back and waited for a superior weapon. But we have a powerful deterrence; practically every informed person says that today we are considerably stronger than any possible enemy

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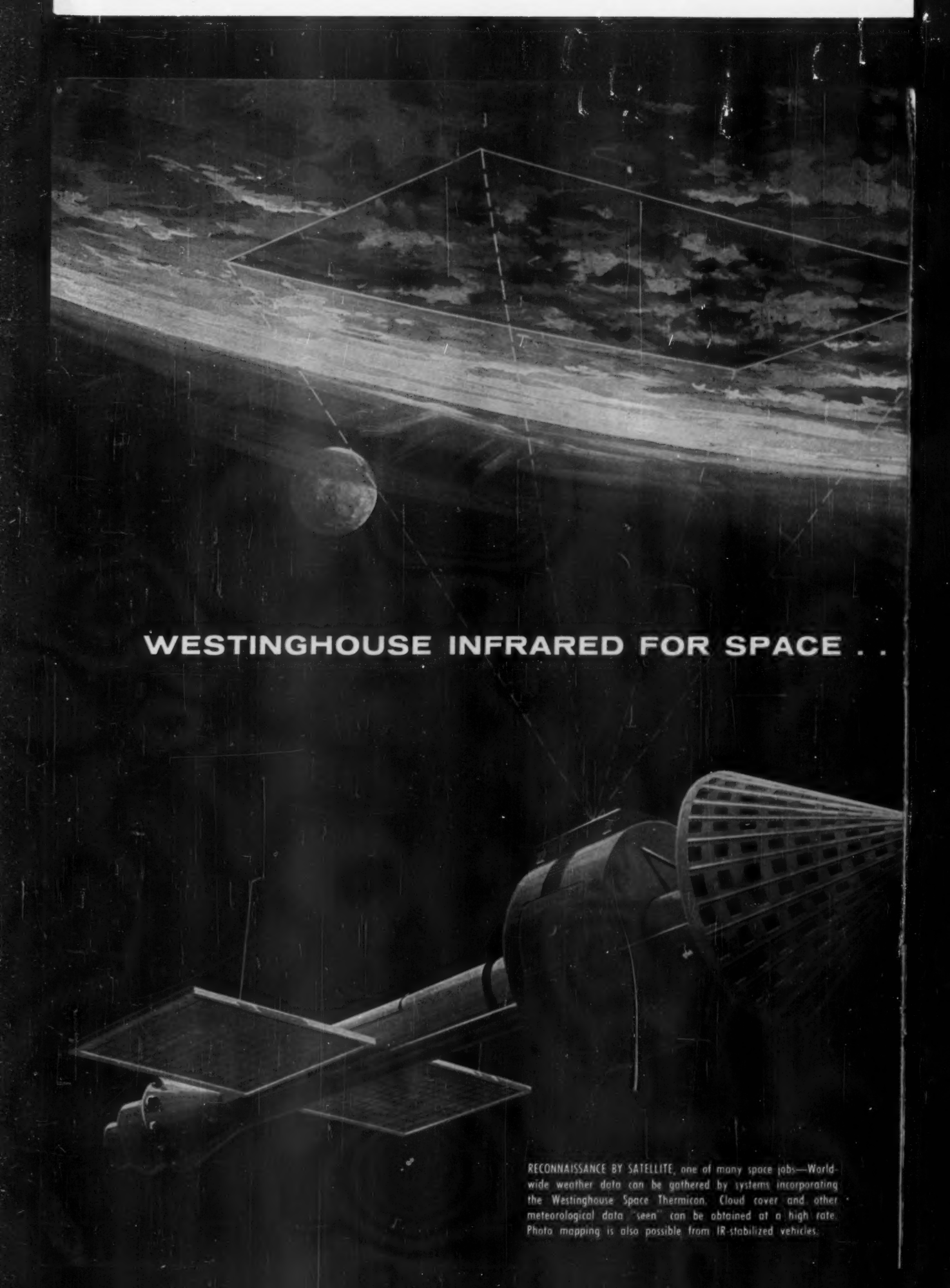

RECONNAISSANCE BY SATELLITE, one of many space jobs—World-wide weather data can be gathered by systems incorporating the Westinghouse Space Thermicon. Cloud cover and other meteorological data "seen" can be obtained at a high rate. Photo mapping is also possible from IR-stabilized vehicles.

1. SATELLITE STABILIZATION—Satellites must keep fixed positions in orbit if they are to perform the vital jobs foreseen for them. A key element designed for such systems is the Space Thermicon, an IR development at Westinghouse. This lightweight, static, electronically scanned "heat-seeing" device operates day or night, guiding the satellite by detecting and responding to Earth's infrared radiation.

2. DETECTING OBJECTS IN SPACE — Fire control systems in stabilized satellites can be designed around advanced Westinghouse infrared equipment. Here static, electronically scanned sensors with a wide field of view can detect and track objects, providing data at a high rate with high accuracy and top reliability.

3. IR COMMUNICATIONS — Westinghouse developments will permit use of active infrared radiations to carry voices or other signals on a narrow microwave beam. Such a system would be almost impossible to detect or jam. It uses low power and requires little weight, and yet is useful for most communication requirements. Its "security" makes it particularly valuable in military applications.

HERE ARE A FEW OF ITS IMPORTANT APPLICATIONS

4. AIRBORNE DEFENSE — Westinghouse-developed infrared devices, techniques, and systems, to detect and track enemy missiles or aircraft, offer vital advantages in both bomber defense and interceptor fire control systems. Such systems operate in daylight as well as darkness. Effective differentiation between targets and background is obtained.

5. TANK FIRE CONTROL — Infrared systems developed by Westinghouse offer special advantages such as 24-hour fire control capability. They are rugged, compact and cannot be detected by an enemy. Electronically scanned sensors eliminate problems of complex optical or mechanical linkage.

6. UNDERSEA DEFENSE — A broad program incorporating Westinghouse developments in scanning systems, sensors, and special circuitry make possible detection of submarines in a tactical environment.

Engineers at the Air Arm Division of Westinghouse Electric Corporation are developing a variety of advanced infrared systems for the Army, Navy and Air Force . . . another demonstration of *Westinghouse Capabilities for Defense.*

WESTINGHOUSE

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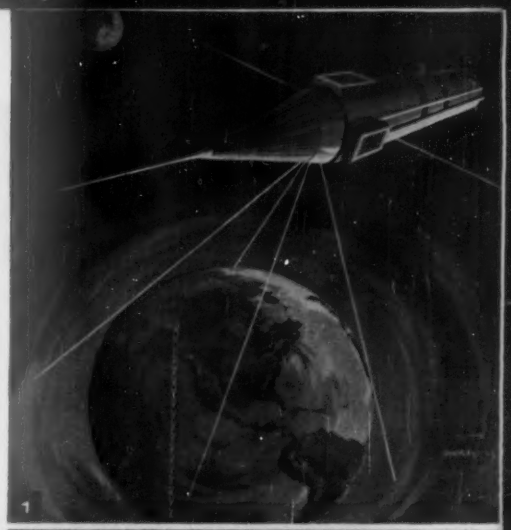
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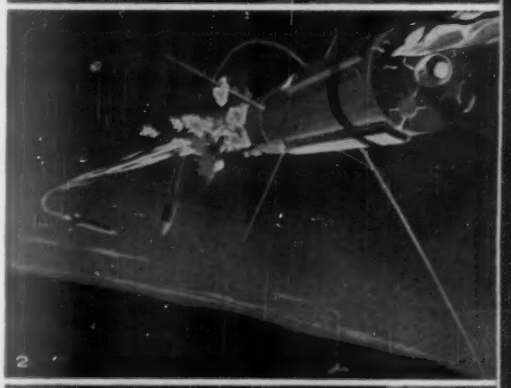
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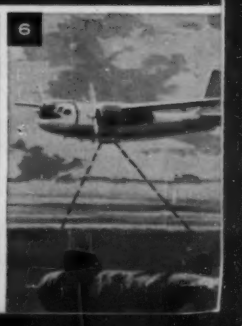
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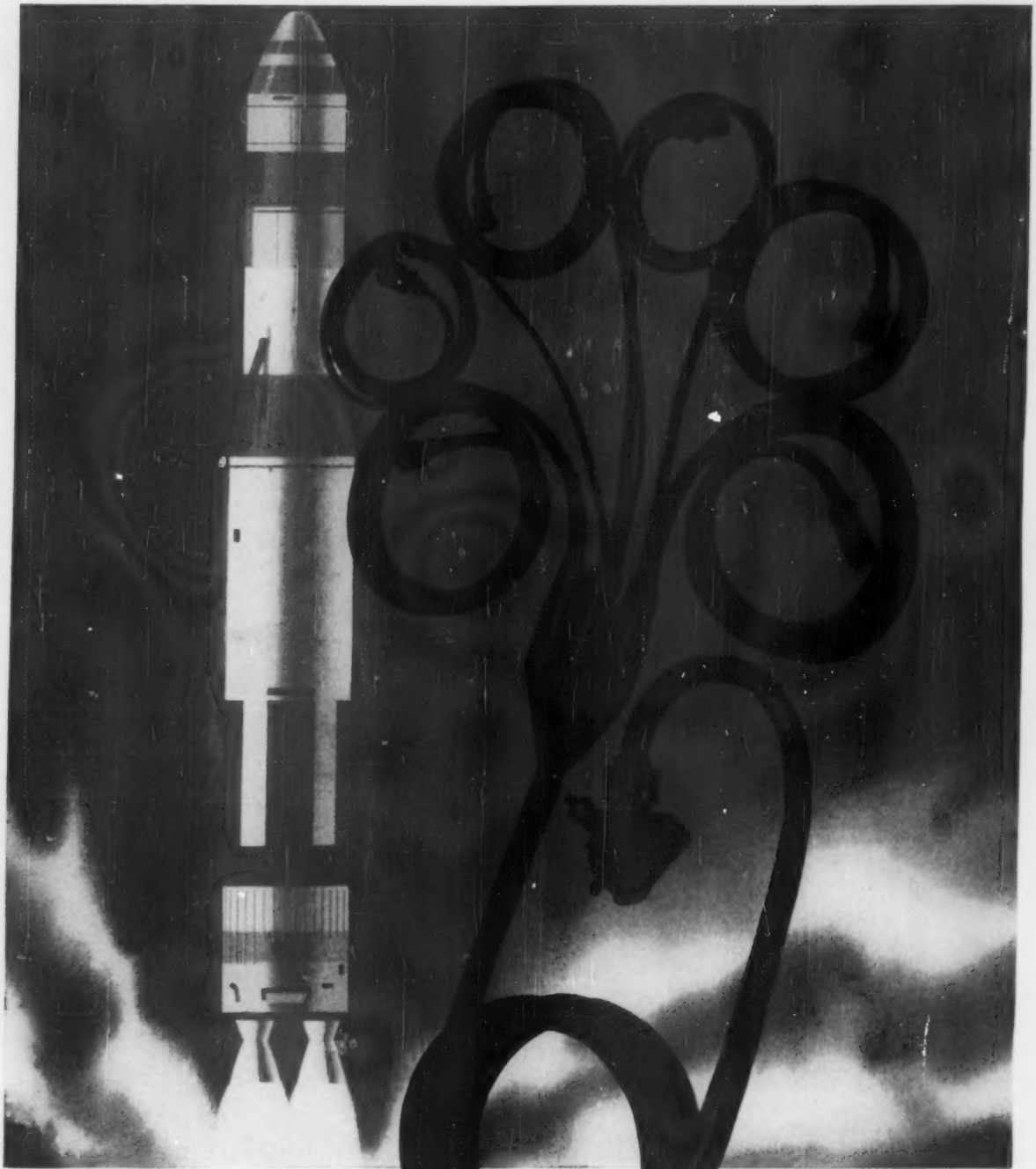

Umbilical

The MSC-built Umbilical Launching Cable... an example of the product diversity of Missile Systems Corporation. Like all products that bear the MSC label, this system has proven its reliability. Just as it is a life-line to the success of a mission, so also are MSC's contributions material to the future accomplishments of *all* facets of the electronic industry. MSC's variety of products form one continual life-line... feeding an industry which is already changing the life patterns of generations to come.

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on earth. Therefore, we can settle on a minimum number of first generation missiles, while pressing forward the development of more advanced weapons, such as the solid-propellant Polaris and Minuteman, relying for our security on our total military power—the greatest military power in the world today and in the world's history.

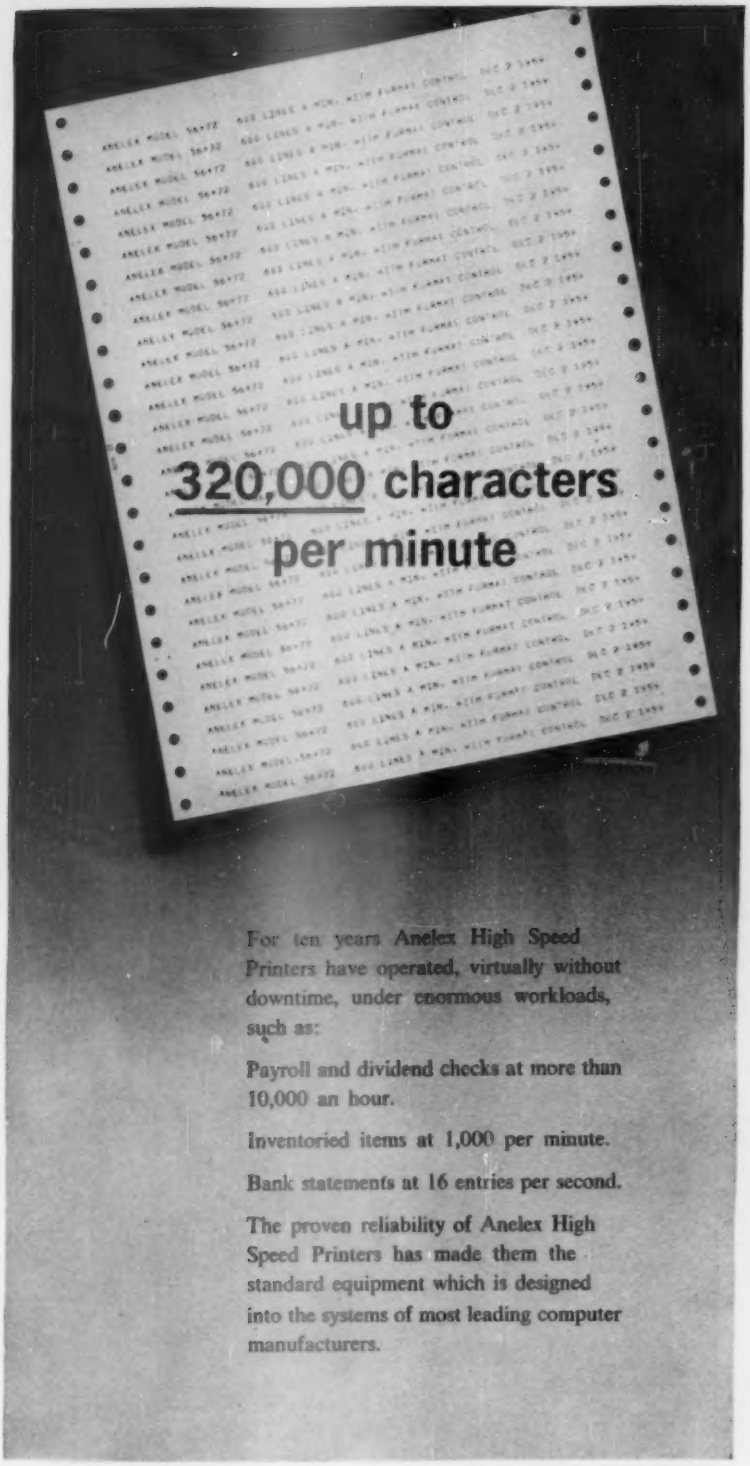
Modernization Plans

Since we are clearly ahead of the Soviets today in total military strength, why is it assumed that we cannot stay ahead? If we should stand still, the Russians could of course reduce and eventually erase the superiority of our present strength. However, we are continually improving our forces. Among our programs for maintaining our position relative to the Soviets are these:

- **Addition this year** of two atomic-powered submarines each equipped with 16 operational Polaris missiles, and a progressive expansion of this force in the years ahead at a minimum rate of three per year.
- **Addition of forces equipped** with the B-58 supersonic bomber in 1960 with a progressive build-up to three wings in the succeeding years.
- **A progressive expansion** of forces equipped with Atlas ICBMs to a total of 13 squadrons by 1963.
- **Addition of forces equipped** with the Titan ICBM on hardened bases in 1961, with a progressive build-up to 14 squadrons sometime after 1963.
- **Addition of forces equipped** with the Minuteman ICBM starting in 1963 with its promise of mobility, and a progressive expansion of this force on into the foreseeable future.
- **Equipping of our B-52s** with the Hound Dog air-to-surface missiles which will enable the bomber to stand several hundred miles away from a heavily defended target and disrupt its defenses with heavy nuclear blasts. These will be operational in the next two or three months.
- **Completion of the replacement** of the Matador with the Mace in the four Matador/Mace squadrons in 1962.
- **The addition of two Army** surface-to-surface and three and one-half Army surface-to-air missile battalions to our overseas development, and conversion of seven other battalions from conventional to rocket-missile capability.
- **The addition of three modern** attack carriers—one with nuclear propulsion—to replace older types now in service.
- **A system known as BMEWS** (Ballistic Missile Early Warning System)—which will give us warning of ballistic missiles on their way toward us to permit us to launch our retaliatory strike. One station will be in operation this calendar year and one next year. These two will make it next to impossible for a mass attack of missiles to come at us undetected. The third station—in the United Kingdom—will come in later.

Thus every element which gives us present superiority over the Russians is being expanded and improved in effectiveness, and many other projects not mentioned above are progressing through the research stage.

We hear much regarding our problem in catching up with the Soviets. The ques-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320,000 characters
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Payroll and dividend checks at more than 10,000 an hour.
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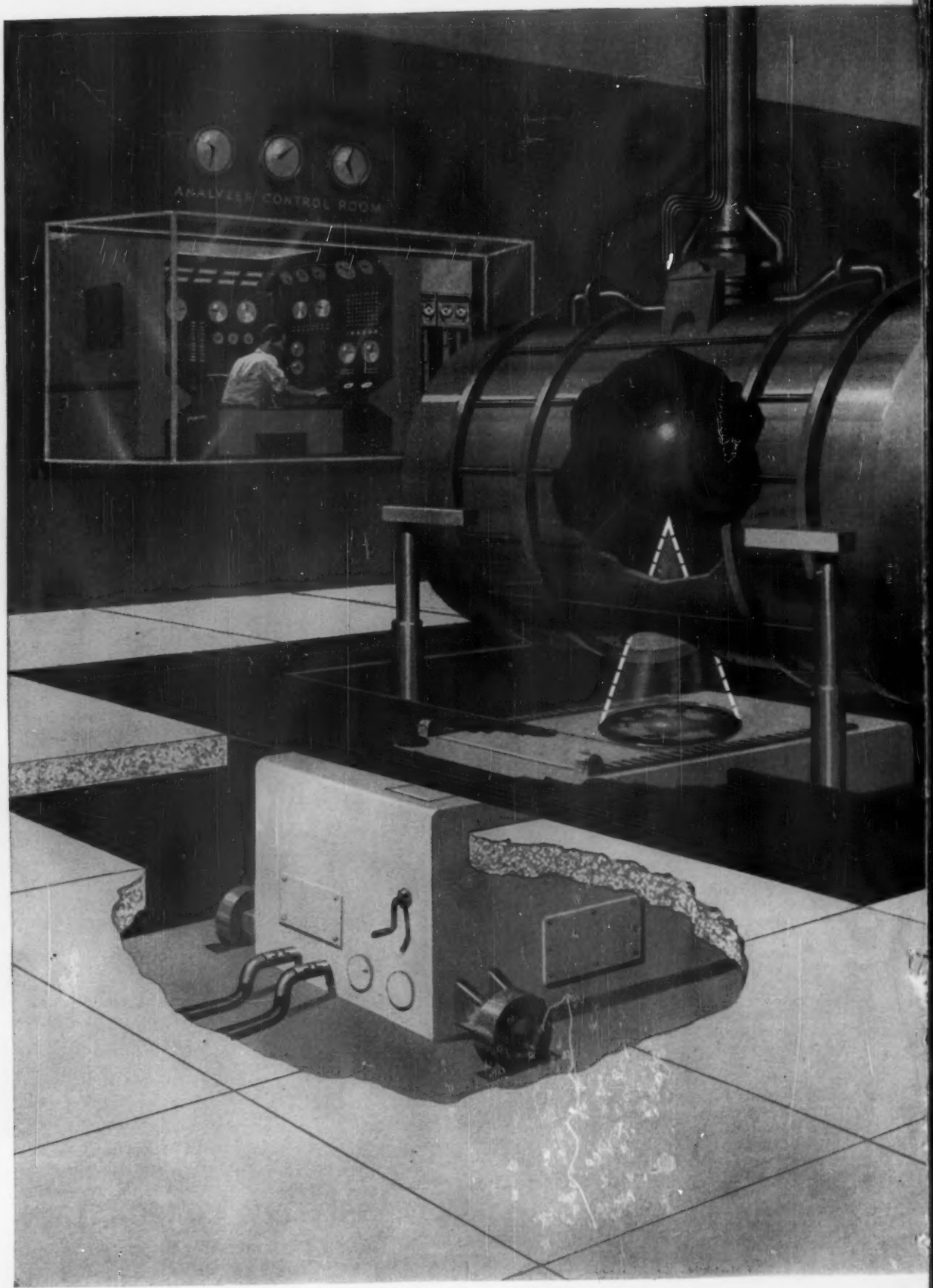
ANALYZER CONTROL ROOM

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Honeywell Dynamic Analyzer recreates authentic shoot environment, pinpoints design deficiencies

The Honeywell Dynamic Analyzer will simulate actual flight conditions from sea level to extremely high altitudes which affect performance and reliability of aerospace systems. An integrated test facility, it brings together for the first time most of the conditions and phenomena that cause aerospace system breakdowns.

It will be independent of the weather, the availability of test vehicles and flight variables. And in many cases, the test data will be more reliable and valid than can be attained in flight testing.

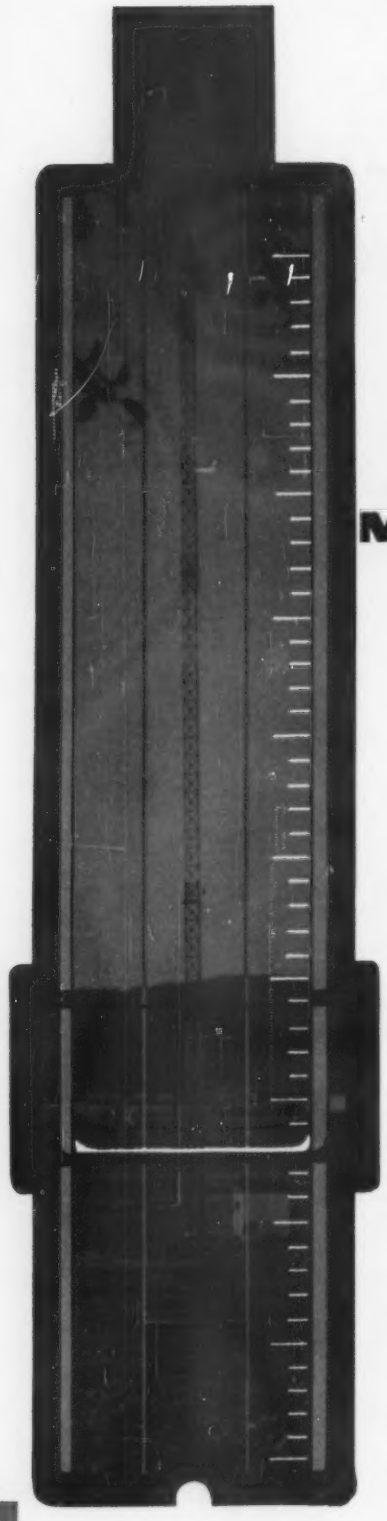
Areas of application include: reconnaissance, guidance, power supply, and communication systems. Tests of complex systems which now might require more than a year to accomplish, will be telescoped down to several weeks. It will be possible to determine which operating systems are detracting from overall performance, and to what degree.

The first Dynamic Analyzer was conceived under the direction of the Aerial Reconnaissance Laboratory of the Wright Air Development Division, USAF. There, the fully instrumented analyzer will be housed in its own building. Capabilities include: high vacuum, high and low temperatures; three-directional vibration; roll, pitch and yaw motion; buffeting; rotation; target variations; controlled ground speed; reflected and transmitted signals.

Honeywell was awarded the prime contract to develop and produce the analyzer on the basis of strong research and development capability. If you have problems in analysis, test or simulation, consider Honeywell's broad experience. Telephone or write: Honeywell, Military Products Group, Minneapolis 8, Minn.

Honeywell

Military Products Group



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tion might better be asked: What can the Russians do to catch up with us?

Defense is a vastly complex subject. We have simply touched the high points of our strategic deterrent position. You have asked for our views on many of the other more specific questions that are being raised and the best way to give these seems to be with attachments. These we are providing.

The Defense Department has sound reasons for the positions it takes. The men who make or participate in these difficult decisions—the Secretary of Defense, the Deputy Secretary of Defense, the Service Secretaries, the Chairman of the Joint Chiefs of Staff, and the Chiefs of Staff themselves are not men who could play fast and loose with the safety of the nation and still sleep nights. The President is not one to make decisions in this area without regard to the nation's security. These people can see the problems as clearly as anyone. Key questions are studied with the benefit of all the intelligence information, with full knowledge of our own plans and the progress of our own plans and with the best military experience and scientific knowledge available in the nation. They are debated, reviewed, settled, re-opened, reviewed again before decision is reached, and even then every major decision is subject to further study and almost continual review. We believe that the reasons behind decisions in these problem areas will carry conviction, and we are glad of the opportunity to state them in the attachments.

Summary

Let me summarize this letter briefly.

The Soviets have placed chief reliance for general war now and presumably for the future on the intercontinental ballistic missile. We have no quarrel with their decision; they have their own situation to consider, with its limitations and its assets, both of which are different from ours.

We include the ICBM as one element in an over-all military capability which takes advantage of our control of the seas, our advanced bases and allies throughout the world, our already-developed superior bomber force and the other strong points in our position. Our preparedness is based realistically on our national policy, which puts us more likely in the position of responding to an attack rather than initiating one. It takes advantage of the fact that our present superior strength enables us to limit our production of the first generation ICBMs while conserving our resources for the more advanced missiles soon to come in. In total, our strength is clearly superior today to that of the Soviets. Our present programs are such that we can say with complete conviction: At no time in the foreseeable future will the Soviets be able to launch an attack upon us without receiving in return a blow of unbearable proportion.

Queries Answered

(The letter was followed by an addendum giving the Defense Department's formal stand on a series of questions posed by Mr. Burgess:)

• **Question:** Are we prepared also to handle limited war?

Research, Development, Test & Evaluation

Direct Obligations, Fiscal Years 1959-60

Washington—Defense Department's Fiscal 1961 budget requests for $3,951.5 million in direct obligations for research, development, test and evaluation falls $319.9 million below the estimates for Fiscal 1960. Reductions were made in the requests of the Air Force, Navy and Advanced Research Projects Agency. Army request, however, was increased from $1,101.3 million in Fiscal 1960 to $1,143.3 million. Here is a breakdown by category and a comparison with the figures for previous years in millions of dollars as supplied by the Defense Department to the House Appropriations Subcommittee:

Defense Department

Category	1959 Act.	1960 Est.	1961 Est.
Military sciences	$401.7	$549.1	$535.2
Aircraft & related equipment	419.5	502.0	446.2
Missiles & related equipment	1,343.5	1,498.3	1,481.6
Military astronautics & related equipment	324.1	408.0	318.0
Ships & small craft & related equipment	163.4	164.4	151.5
Ordnance, combat vehicles & related equipment	197.0	198.9	177.5
Other equipment	434.4	558.3	460.5
Program-wide management & support	251.0	248.4	231.0
Emergency fund	.....	141.0	150.0
Total direct obligations	$3,543.6	$4,268.4	$3,951.5

Advanced Research Projects Agency

Military sciences	$46.6	$132.3	$144.0
Military astronautics & related equipment	103.0	111.9	67.0
Program-wide management & support	3.1	4.0	4.0
Total direct obligations	$152.8	$248.2	$215.0

Air Force

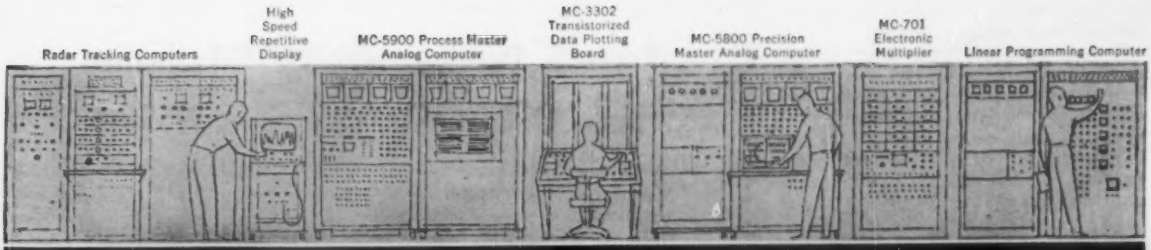
Military sciences	$135.1	$122.4	$116.8
Aircraft & related equipment	273.4	370.0	312.7
Missiles & related equipment	292.0	317.2	318.2
Military astronautics & related equipment	221.0	296.1	249.7
Ordnance, combat vehicles & related equipment	7.7	13.9	13.0
Other equipment	175.0	302.1	229.4
Program-wide management & support	117.5	104.5	97.4
Total direct obligations	$1,222.2	$1,526.6	$1,337.5

Army

Military sciences	$123.3	$159.1	$150.9
Aircraft & related equipment	54.4	36.2	36.6
Missiles & related equipment	423.1	495.5	493.8
Ships, small craft & related equipment	2.3	.9	.1
Ordnance, combat vehicles & related equipment	118.9	108.7	88.5
Other equipment	212.2	204.7	185.9
Program-wide management & support	87.0	96.1	187.2
Total direct obligations	$1,021.5	$1,101.3	$1,143.3

Navy

Military sciences	$105.5	$135.1	$123.4
Aircraft & related equipment	91.5	95.7	96.8
Missiles & related equipment	628.2	685.5	668.5
Military astronautics & related equipment	.....	.....	1.3
Ships, small craft & related equipment	161.0	163.4	151.3
Ordnance, combat vehicles & related equipment	70.3	76.1	75.6
Other equipment	47.0	51.3	45.1
Program-wide management & support	43.2	43.7	45.5
Total direct obligations	$1,147.0	$1,251.1	$1,207.5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• **Answer:** Because the debate this year has been directed largely toward our preparedness for all-out nuclear war, public attention is being focused mostly on this part of our problem. Actually, there is more likelihood that if we fight at all in the near future it will be in some kind of limited war.

Over-all, the Joint Chiefs consider that the limited war capability that we have in being in the Army, Navy, Marine Corps and considerable portions of the Air Force, plus our reserves and the forces of our Allies, are adequate to handle any contingency that can reasonably be foreseen.

The active forces we have for dealing with limited wars include the following (some can be listed also as part of our deterrent to general war, since they are clearly capable of performing in both limited and general war situations):

1.—Fourteen Army divisions, of which seven are deployed in Europe and Korea, and one (slightly reduced) is in Hawaii. Three Strategic Army Corps divisions are maintained in a high state of readiness in the United States.

2. Four fleets of naval alert forces prepared for any eventuality from showing the flag to general war operations. These fleets include 14 attack carriers, 9 anti-submarine carriers, 13 cruisers, 237 destroyer types, 115 submarines, 82 mine craft, about 7,000 operating aircraft, and the highly trained and ready Fleet Marine forces. These latter forces consist of 1 division-aircraft wing team based on the East Coast with at least one battalion landing team and supporting aviation afloat in the Mediterranean, one division-aircraft wing team based on the West Coast and a third division-aircraft wing team based in the Western Pacific.

3.—Thirty-four tactical Air Force wings, equipped, trained and ready for combat, of which 2 tactical bomber wings, 9 tactical fighter wings, 3 tactical reconnaissance wings, 4 troop carrier wings, 5 tactical missile squadrons and 18 air defense fighter interceptor squadrons are deployed overseas. Seven tactical fighter wings are located in the United States available for deployment anywhere needed.

4.—Some 200 allied divisions with essential supporting air and naval forces. These forces have been or are being supported in some degree by our Military Assistance Program. They vary in their capabilities and would serve primarily to resist localized aggression until we are able to deploy our own ready forces to assist them; in some cases they would be available for employment outside their own homeland on a regional basis.

At Quemoy, at Lebanon, in more than a dozen situations in the last ten years, we have deterred the aggression of international communism, because we were able to bring quickly to the scene the required level of force, always quietly backed up by the total power of our United States military might.

• **Question:** Could a sneak attack of 300 Soviet missiles wipe out our ability to counterattack, as has been said?

• **Answer:** This refers to a hypothetical mathematical exercise developed as part of the argument in support of an airborne alert.

The validity of this hypothesis, which as-

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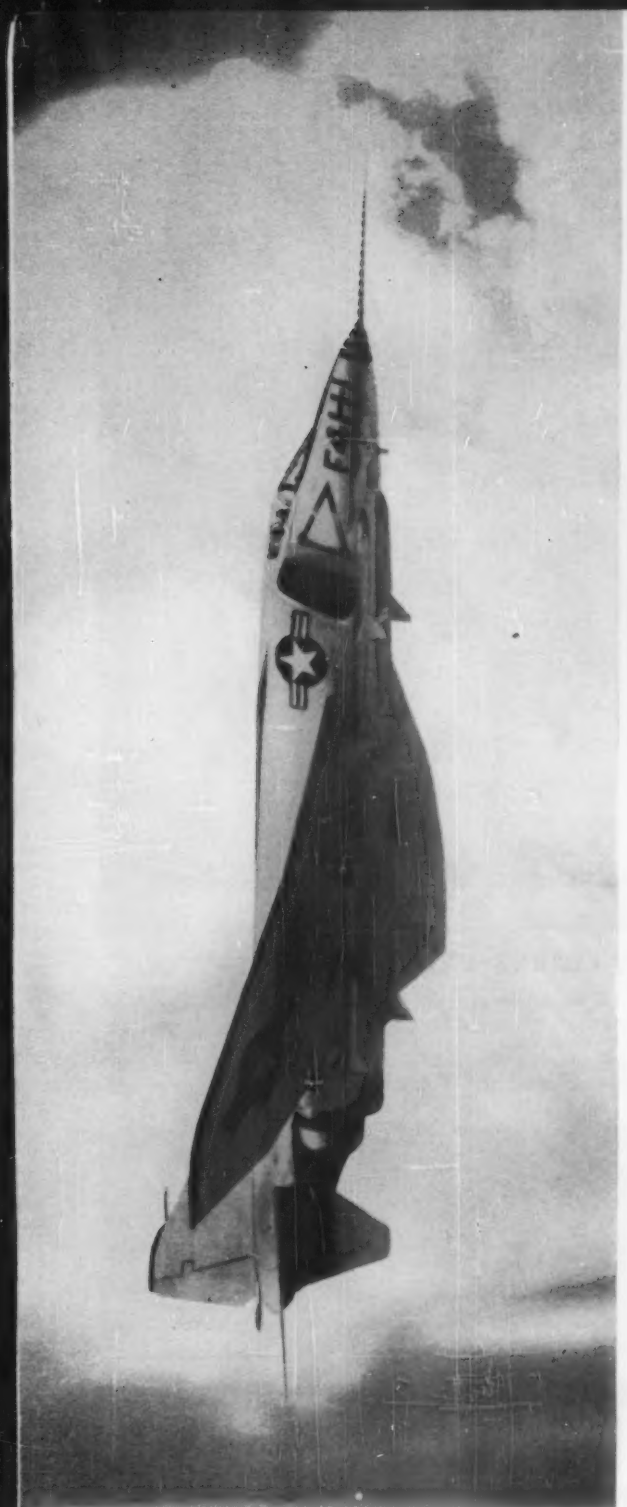

These major aircraft of the U.S. Air Force electronic systems developed and

Official U.S. Navy photo

(Clockwise from left) U.S. Navy F4H-1 "Phantom II" is armed with Sparrow III air-to-air missile. B-47 "Stratojet" is equipped with Raytheon electronic countermeasures equipment. Defensive armament for F3H "Demon" is Sparrow III. B-52 "Stratofortress" uses Raytheon high speed bombing radar and B-58 "Hustler" has search and Doppler-navigation radar supplied by Raytheon.

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For more information about MSVD's space navigation and control work for the Air Force and its other contributions to U.S. space technology progress, write to Section 160–73, General Electric Missile and Space Vehicle Department, Philadelphia 4, Pennsylvania.

GENERAL ELECTRIC

MISSILE AND SPACE VEHICLE DEPARTMENT

A Department of the Defense Electronics Division

Scientists and Engineers interested in career opportunities in Space Technology, contact Mr. T. H. Sebring, MSVD

sumed the Soviet capability to launch 300 long-range missiles against the United States targets of today, depends on a number of "if," such as:

1.—If the Soviets have not only the missiles but also the required numbers of launching complexes from which "300" missiles could be launched at close to the same time.

2.—If these missiles have such reliability—could be launched on such a perfect countdown schedule and would perfom so perfectly thereafter—that they would land on their targets in the required numbers at the precise planned moment. (If a carrier in the Mediterranean is struck before a base in Alabama, we can put much of our retaliatory power on its way.)

3.—If the massive national effort required for such a gigantic operation could go undetected by our intelligence.

4.—If all of our long-range strategic bombers were on the ground at their bases, and the locations of our aircraft carriers known.

5.—If the Soviets are willing to take the gamble that every detail would work perfectly, as it would have to work for such an attack to succeed—knowing that any miscalculation or slip-up would wreak havoc on their country.

The improbability that all of these conditions would obtain is obvious.

• **Question:** Why has defense slashed the B-70 program and decided to go ahead only with two prototype planes?

• **Answer:** The Air Force program called for the development of a Mach 3 heavy bomber to be operational in 1965. Success of the program will depend on distinct advances in the state-of-the-art of manned aircraft involving new components, new metals and so forth. Many technically qualified people believe the program priced at $5.5 billion may be optimistic both in terms of cost and time period. It might come in as late as 1967 or 1968.

Plans to produce the B-70 as a weapon system have been deferred because:

1.—Even by 1965 we will have four strategic intercontinental missiles operational—Atlas, Titan, Minuteman and Polaris. The B-70 would, therefore, come in competition with these other ways to do a single purpose mission.

2.—The advantage the B-70 would have over a B-58 in that time period is distinctly questionable. It is hard to believe, for example, that a Mach 3 bomber will present an appreciably more difficult target to the ground-to-air missiles of 1965 than a Mach 2 airplane.

Decision to proceed with the aircraft itself was made because we are not yet prepared to stop research effort looking toward advances in the state-of-the-art in manned aircraft. Frequently the potentials of new scientific developments are hard to foresee in full, and we do not think it wise to drop entirely research in the field of advanced aircraft.

The B-70 will, therefore, be carried on as a research and development prototype, not as a full weapons system development. This will permit us to work out the problem of a large airframe and propulsion system at Mach 3 and the door will be kept open to future consideration of the B-70 as a weapons system.

• **Question:** Shouldn't we have an airborne alert—so that our planes, on which we place our principal reliance these days, will not be caught on the ground by a surprise attack?

• **Answer:** There is substantial capability for an airborne alert inherent in the Strategic Air Command today—for limited periods and when international storm signals indicate that such action would be prudent, rather than merely provocative. Even now we have a small number of planes in the air at all times—with weapons and assigned targets.

The FY 1960 budget provided about $140 million and the FY 1961 budget about $90 million for training additional crews, buying jet engines and other spare parts that would be used up at a fast rate, and in general providing for an increased airborne capability. Also, Congress has provided in the '60 budget and is being asked to provide in the '61 budget that if at any time the President decides we should go to an airborne alert in an emergency situation, we can go ahead and do so, and simply overspend our appropriation by the necessary amount. Funds, therefore, are not a major consideration.

Manned Bomber Threat

Today the threat is from manned bombers —and will be until the Soviets have enough intercontinental missiles, and launching facilities to such numbers that they can fire several hundred almost simultaneously. We now have in operation systems which will give us warning of any bomber attack. A substantial portion of SAC is on a 15-minute ground alert. That is, the crews are briefed, the aircraft are serviced and ready, and all that is needed is the signal to send them on their way—half way around the world if necessary.

A large-scale continuous airborne alert is not needed or desirable today. By the time it may become necessary in the future, we will have the capability.

• **Question:** Some knowledgeable people have testified that they believe that the modernization of the Army should proceed faster than the 1961 budget allows. Will this budget give us a modern Army?

• **Answer:** We are not moving as rapidly in this field as the Army would like. However, we do have a sound program which is providing significant quantities of equipment in all the general fields which the Army considers essential to its modernization.

Modern Missiles. 1961 will see the first deliveries of Davy Crockett, the man carried, nuclear capable rocket for use by front line troops, as well as the new light weight air-transportable Little John rocket and the much larger and longer-range Sergeant missile. In addition, in FY 1961, new deliveries will provide a substantial increase in the inventory of the Hawk surface-to-air missile which will provide field forces with a highly mobile defense against aircraft and air-breathing missiles. The FY 1961 budget provides for a continual build-up of our inventory of these important contributions to Army fire power as well as initial procurement of Redeye, a portable missile for defense of field forces against low-flying aircraft.

Tanks and Artillery. During FY 1961, 720 of the new M-60 tanks armed with the 105 millimeter high velocity gun and equipped with a longer-range diesel engine will be delivered. The FY 1961 budget provides for continued procurement of this tank as well as initial purchases of a new family of self-propelled artillery pieces.

Tactical Mobility. Army tactical mobility is being enhanced by procurement of the lightweight M-113 armored personnel carrier, two types of improved helicopters, and the Caribou transport aircraft, and about 21,500 trucks, trailers, jeeps, and other tactical vehicles.

Battlefield Surveillance. Improved battlefield surveillance will be provided by the acquisition of limited quantities of surveillance drones, modern helicopters, and the Mohawk turboprop observation aircraft.

Small Arms. In 1961 the Army will also receive about 180,000 of the new M-14 NATO-standard 7.62 millimeter rifles and almost 15,000 7.62 millimeter machine guns. The FY 1961 budget will permit procurement of an additional 120,000 rifles and 12,000 machine guns.

Also, improved communications—electronic equipment will be added to the Army inventory.

In 1961, the Army plans to obligate $1,524 million for all procurement, as compared to $1,388 million and $1,097 million for 1960 and 1959 respectively. Of this total, the Army's share of the "Ordnance and Vehicles" procurement activity, in which the bulk of ground force modernization items other than missiles are included, will experience an increase by 1961 to a level well over 300 per cent of that of 1959.

An essential element of modernization is continued research and development. The Army budget for FY 1961 includes over $1 billion for this purpose. A little over one-fourth of this amount is devoted to the Nike Zeus program, but the remainder gives significant support to the whole range of problems which must be solved in maintaining a modern Army.

The essence of this program is that it provides for an orderly improvement of our Army's capabilities, both conventional and nuclear.

• **Question:** Can you explain how, using the same Central Intelligence figures, Secretary Gates can say the Soviet missile threat has lessened (the "gap" narrowed) and someone else say it is the same as last year or even worse?

• **Answer:** Last year we had available to us the National Intelligence Estimate which gave us the numbers of operational ICBMs which the USSR could achieve or might achieve in various time periods. These were calculated to cover either of two possibilities: one, that the Soviets would pursue a vigorous but orderly ICBM program, and the other, that they would pursue a highly accelerated or "crash" program.

A year has now passed. Additional information has been acquired and further refinement has been accomplished. Considering all the available evidence, we believe it is now well established that the USSR is not engaged in a crash program for ICBM development.

If one compares the current estimate

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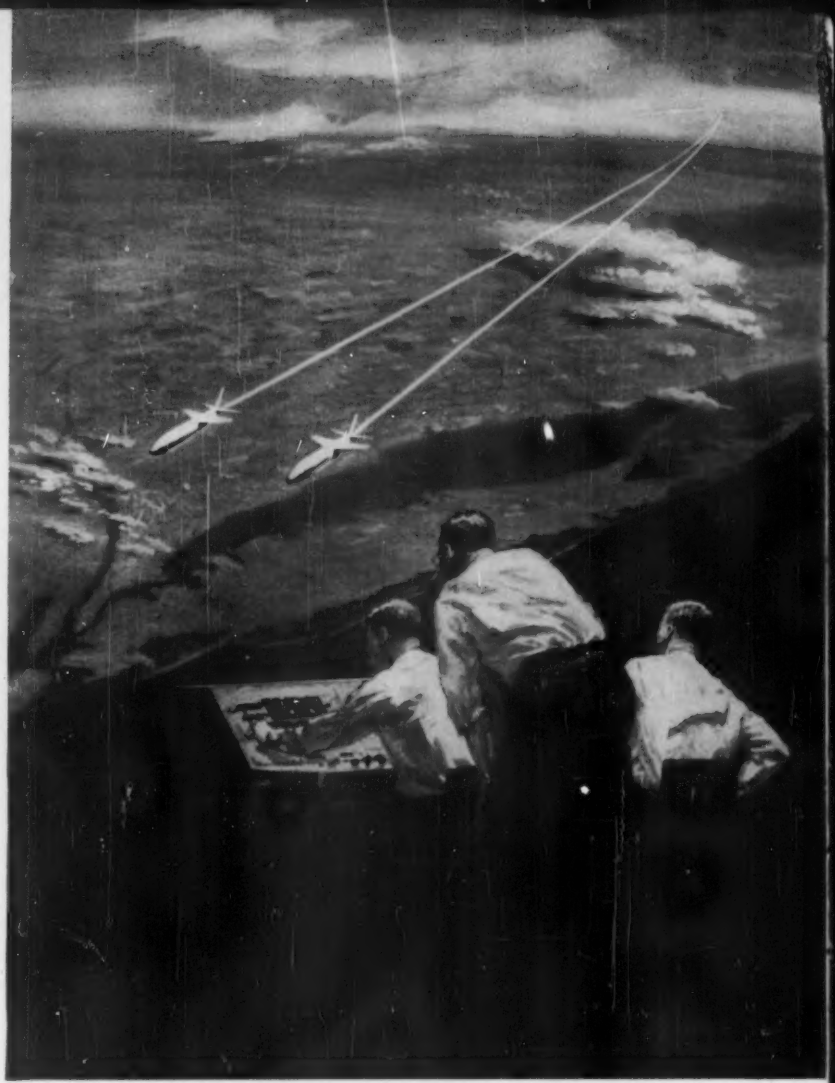

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SPERRY

against the "crash" program—and in our defense planning we had to consider the least favorable contingency—it is clear that there has been a distinct lessening of the threat. If one compares the estimate for this year against the orderly program estimated last year as one possibility—there is little change.

• **Question:** Secretary Gates refuses to talk in terms of a ratio, such as the 3-1 numerical superiority some say the Russians will have over us in the next two year. What is the correct ratio?

• **Answer:** The reason we shy away from such ratios is that they are meaningless and simply confusing. You can get almost any ratio you want, depending on your own ground rules.

In comparing intercontinental missiles, do you include Polaris? Do you include all the Polaris, or since only two-thirds of the submarines will normally be at sea at a given moment, do you include two-thirds of them? Or do you include only one-half because not all of them will be within targeting range at a given moment. Do you include the Snark, an air-breathing intercontinental missile? Do you include all the Atlases, or only those ready to be fired within a certain number of minutes?

How do you count the Russian ICBM? Do you try to guess how many of theirs are on the same degree of readiness, or do you count all of theirs on the assumption that you have to play it safe?

Our ratio will depend on your decisions on all these and other matters.

Furthermore the numbers are misleading because factors that deal with time of warning, relative hardening, dispersal, mobility, and most important, accuracy, must also be considered. If you change any factor in this formula you change the result.

As long as different people wish to prove different things, it will be impossible to agree on common ground rules and assumptions, and to derive a meaningful ratio.

• **Question:** The Army has urged more money for Nike Zeus, calling it our only defense against ballistic missiles. Why are we dragging our feet on it?

• **Answer:** We are acutely aware of the need for developing an effective anti-missile defense with all possible haste. The most advanced of our efforts is Army's Nike Zeus.

Nike Zeus Program

This system, however, is still in the development stage. It has some serious unresolved technical problems. Also, each installation would protect only a very limited area; the missile has a range of about 75 naut. mi. This means that to give effective protection to the population of this country we would have to have Nike Zeus installations in great numbers, at a tremendous cost.

Whether this ultimately makes sense will depend in part on how well it works.

We are going all-out in the research and development effort to solve the remaining problems and then to evaluate the resulting system. The thing we are not doing is going into production of the system at this time. As much as we would like an anti-missile weapon, the Nike Zeus is simply not advanced sufficiently to be placed in production. This is the combined judgment of most of the best military and scientific advisers in the country.

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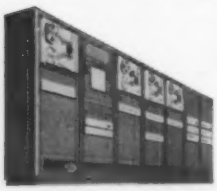

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Mice Used in Preflight Radiation Tests

By Russell Hawkes

Los Angeles—Preflight exposure of space pilots to strong magnetic fields may raise their tolerance to nuclear and Van Allen radiation belts, reduce their food requirements and even lengthen their natural lives for multi-decade missions outside the solar system, according to clues found in research with mice.

Whether these effects can be produced in man and without dangerous side effects remains to be proven, Harold S. Alexander, human factors engineer of North American Aviation Missile Division told the Institute of Environmental Engineers here.

Biological damage by strong magnetic fields is possible and deserves consideration since such fields are likely to be present in space vehicles with ion or photon motors or fusion reactors. Alexander called for caution in subjecting human beings to strong fields because long-term exposure of man has not been studied and extrapolation from mice to men is not valid.

Alexander summarized results obtained by many scientists in the field. Research into biomagnetic reduction of ionizing radiation damage to the body reported most completely by Alexander was undertaken by Jeno M. Barnothy of Evanston, Ill.

Barnothy exposed mice in plastic cages to permanent magnetic fields of 4,400 Gauss at the center of the cage and 4,000 Gauss at the edge of the cage. In the first series, nine animals at the age of 40 weeks were treated for a period of five weeks. In the second series, nine animals at the age of nine weeks were exposed for a period of four weeks. After two weeks of exposure white blood cells had decreased by 28% in the first group of mice and by 48% in the second group. After removal from the field, the number of white cells rose to a maximum for most of the animals in about a week. The mean increase in white count of the first group of mice was 135% and that of the second group was 226%.

This effect on white cell count is opposite to that produced by ionizing radiation and occurs at a different time with respect to exposure. To determine if magnetic effects could be used as a radiation sickness preventive, Barnothy exposed eight mice of average weight to a 4,200 Gauss magnetic field for 14 days. The mice were then exposed to 57 Roentgens per minute of gamma radiation from a cobalt 60 source at different times over a three-day period after removal from the magnetic field. A complicating factor is that probability of death due to radiation is higher if body weight is low. Exposure to magnetic fields retarded growth of the mice an average of one or two grams. Mortality percentage of the treated group was from 9% to 30% lower than that of the untreated control group. Barnothy's wife Madelcine, also engaged in this research, reports that magnetic field treatment also seems to be beneficial after exposure to radiation. Mice placed in a magnetic field for 50 hr. immediately after whole body radiation had a 50% lower mortality rate than those not given the post-radiation treatment. It may be possible to use this effect to save the lives of workers accidentally exposed to radiation.

Magnetic fields have also been shown to have strange effects upon the metabolism and bodily development of mice. Mice subjected to a mean field strength of about 4,200 Gauss ate about 14% less food throughout their life span than unexposed mice. If the same effect is produced in man, it could reduce load requirement of manned vehicles. Retarded growth could be detected in young mice exposed to magnetic fields. The retardation of males has been found to be greater than that of females. Very strong fields or fields with steep strength gradients completely arrested the growth of the animals.

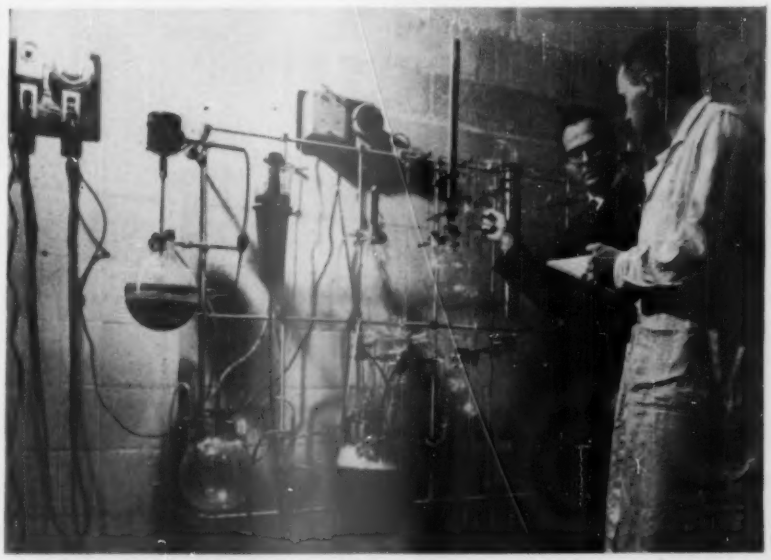
If exposed before puberty, mice tolerate the strongest homogeneous magnetic fields without serious harm. Male mice placed in strong or steep gradient fields seven weeks after puberty died within 10 days.

Livers of those killed by steep gradient fields were found to weigh only half as much as those of the controlled animals.

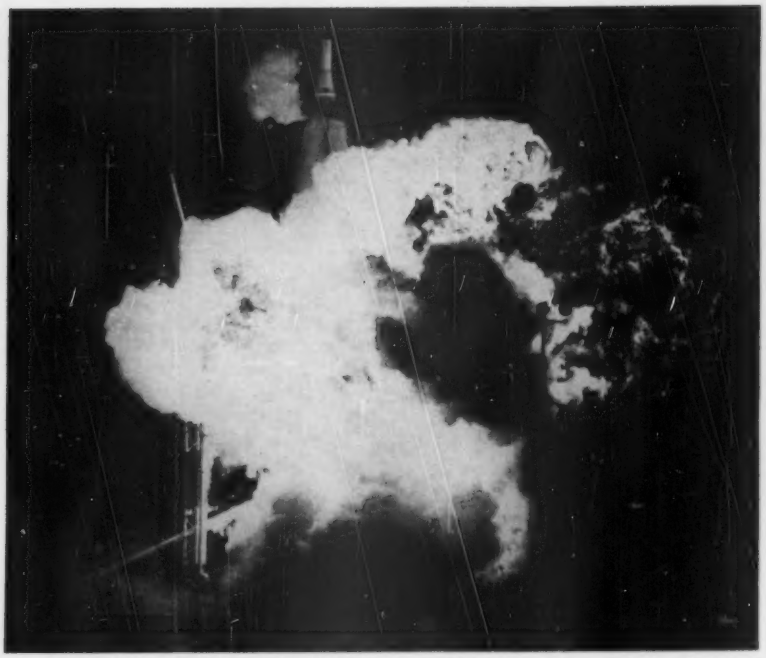
Pregnant females subjected to 2,500 Gauss bore healthy offspring which remained about 20% smaller than normal throughout their life. Body temperature was 0.8C lower while in the magnetic field and for one month after removal. At 3,100 Gauss, mice bore young which lived only a few days. Embryos were reabsorbed by the mother at 4,200 Gauss.

Alexander also cited work which demonstrated that oxyhemoglobin content of the blood rises from 5% to 25% after 20 min. exposure to magnetic fields.

Alexander said, "One of the most surprising effects of magnetic fields on mice was that of appearance. Photographs by Barnothy of two animals 400 days old (average life span is 370 days) showed that the fur of the treated



CLOSED WASTE recycling system that has space crew applications has been developed by Dr. D. D. Chapman (left), Boeing Airplane Co. bioscientist, in cooperation with University of Washington. Chapman and R. H. Berg tabulate flow information; system processes liquid into drinking water and algae for food and develops bacteria to break down w[illegible]s.



Atlas 51-D Explodes at Cape Canaveral

Atlas 51-D explosion on Pad 11 at Cape Canaveral, Fla., put the pad out of commission until about June 1. Pad 13, damaged by a launch explosion on Mar. 10, also cannot be used until about June 1. These are two of four pads available for the Convair Atlas; the third and fourth, however, have been designated for Midas and Mercury space launches.

animal had a smooth, youthful appearance whereas the untreated animal fur showed signs of aging in stripes and skin wrinkles. Treatment consisted of exposure for four weeks and proved effective only in mice younger than seven months."

In his commentary, Barnothy said, "We are now engaged in experiments to find out whether with proper treatment we could not lengthen the life span of mice. From the preliminary results this does not seem impossible. It would take a space pilot 40 years to reach the nearest star if he would travel with one-tenth the speed of light. But, I leave it to your imagination what a lengthening of human life could imply in other respects, too."

In certain circumstances a magnetic field may produce in human subjects an illusion of flickering light. If space pilots are subjected to strong fields, this effect, known as a magnetic phosphene, may hamper vision.

Alexander said cost, size and weight of equipment capable of generating closely controlled magnetic fields is a serious obstacle to thorough research into biomagnetic effects. Field generator should be able to vary and control frequency and intensity from zero to 100 cps. and from zero to 15,000 Gauss, should have adjustable 9-in.-diameter hole pieces with a maximum air gap of 9 in. and should have very low noise level. Temperature in the facility should be controllable. Cost of a 3,600 kva. power supply for this purpose is estimated at $600,000. The magnet would cost another $75,000 and operating costs would be high. The weight of the coil and core is set at about 5½ tons and would occupy a space 4 ft. x 8 ft. x 6 ft. It may be impossible to achieve whole body treatment of human beings because of high costs.

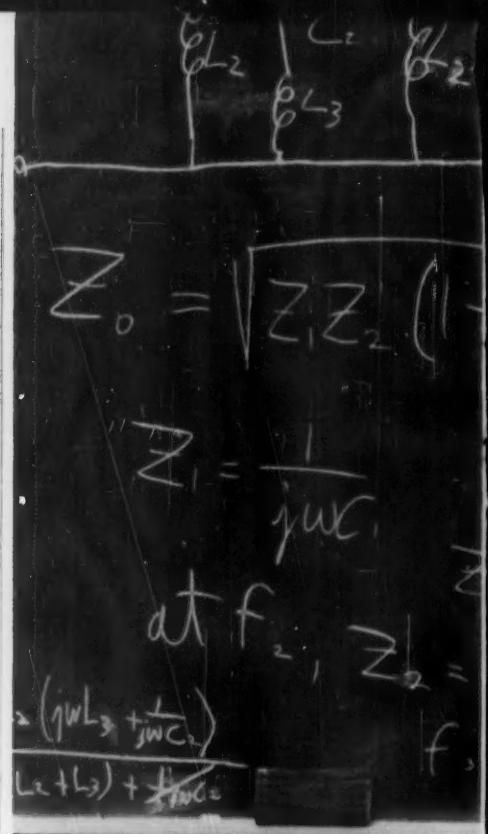
Permanent magnets will probably be used in early studies. They are portable and costs are low but they have the disadvantage of relatively fixed strength.

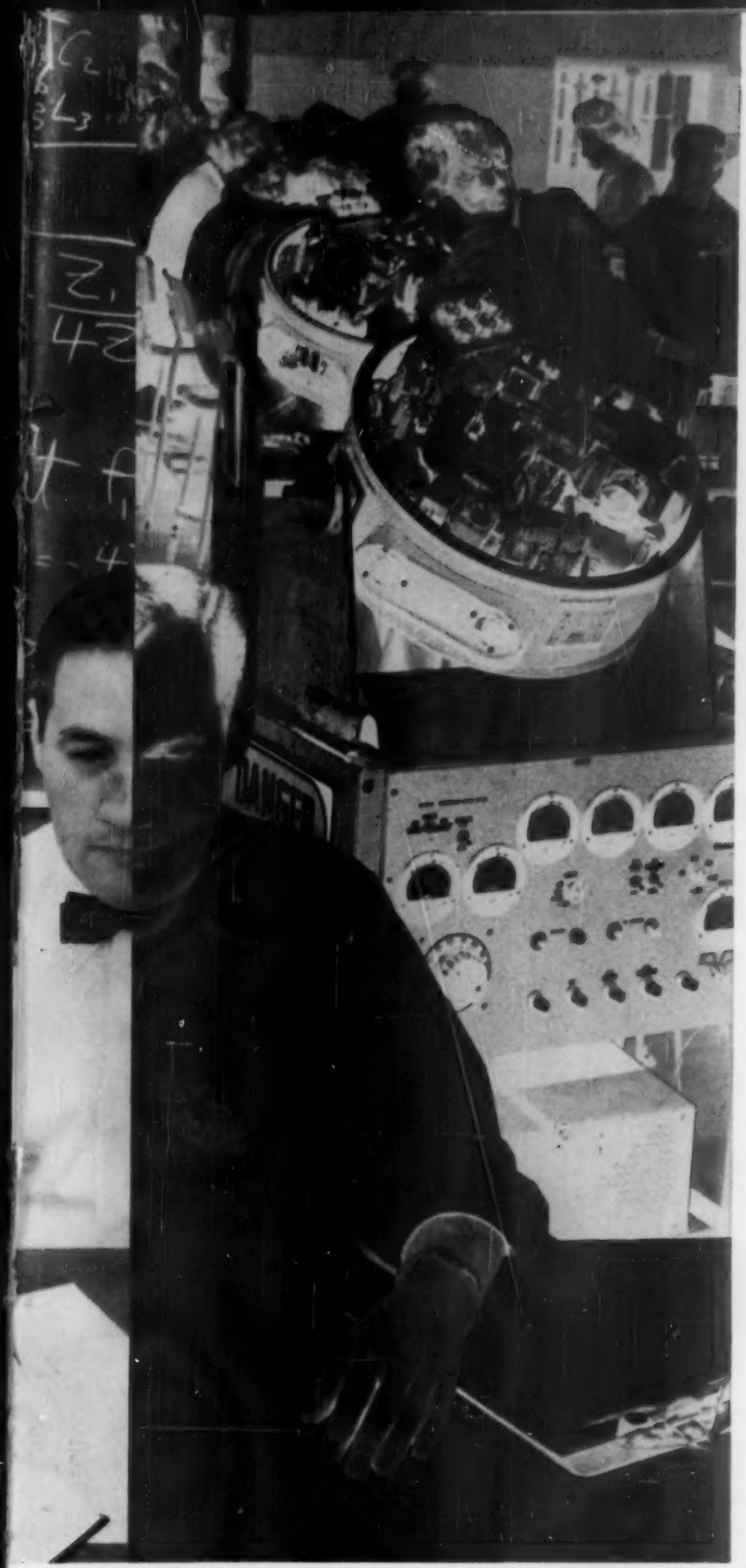
Research on a large scale is likely to require a joint use facility with considerable flexibility of application. As yet no satisfactory design has been proposed. First electromagnets to be used will probably operate on direct current as alternating current magnets are more expensive to build and operate.

Problems and possibilities of using green plants to produce oxygen and food for long duration missions into space were outlined by S. P. Johnson, Boeing Airplane Co. space medicine section.

In a closed ecological system, different nutritional requirements of plants and human beings can pose a problem. They have similar requirements for inorganic ions other than sodium and chlorine.

About 30% of the total weight of ions required by the human body is for sodium and another 50% is for chlorine, but these are regarded as trace





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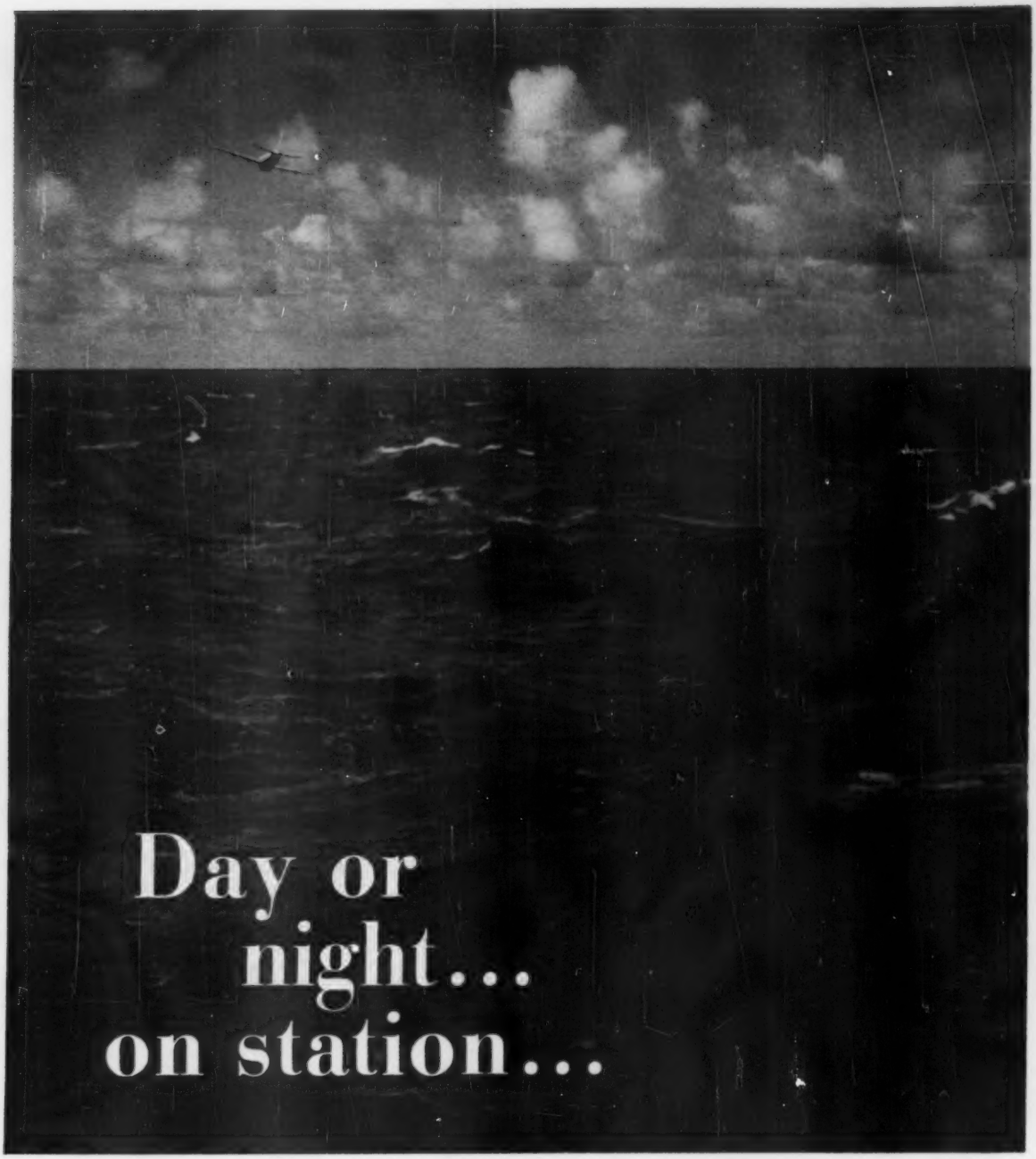

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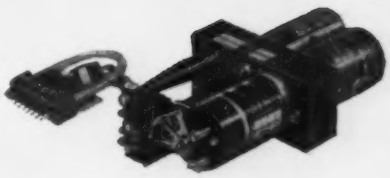

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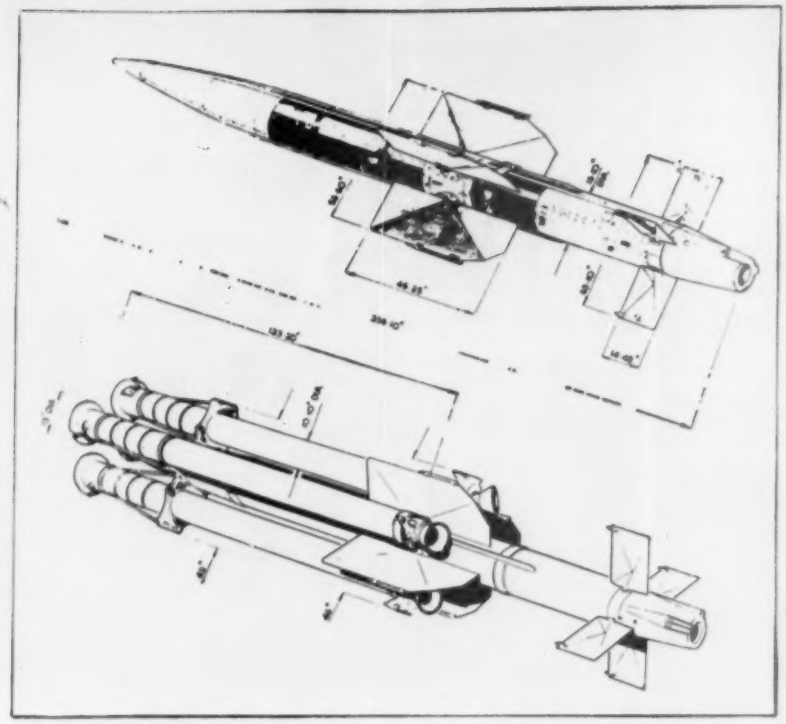

Wing Changed on Armstrong Whitworth Seaslug

Armstrong Whitworth Seaslug, ship-to-air missile being developed for Britain's Royal Navy, is 20 ft. long. Cruciform wings, previously installed in a rectangular shape (AW Mar. 9, 1959, p. 261) have been cropped at the trailing edge, probably due to flight stress problems encountered with the previous wing.

elements in plant nutrition and are toxic at present in quantity. A closed ecological system must be able to remove excess sodium and chlorine from human waste and convert it into table salt.

Other components of human waste such as bile pigments and certain aromatic compounds must be altered chemically into forms usable by plants.

The broad leaf plants which seem most useful for food and as oxygen producers in a closed ecological system are cabbage, lettuce, turnip, spinach and carrots because they have large leaf areas for efficient photosynthesis and are highly edible. Weightlessness is not expected to be a serious problem for broad leaf systems since their orientation is mainly phototropic and chemotropic. Algae will not suffer from weightlessness because they grow in a liquid medium. However, it may prove difficult to aerate the culture and recover the algae-produced oxygen.

Abrupt temperature changes are adverse to plant growth. Wide fluctuations can be tolerated if they are gradual. Temperature must be synchronized with the light-dark cycle to which the plant is subjected. Prolonged constant temperatures can be damaging or even lethal.

The broad leaf plants receiving most consideration are considered cool season crops. Temperature should be about 65F during the dark period and 75F in illumination. Temperature cycling may not be necessary for some strains of algae. One moderate temperature strain is known to grow best at 25C and the high temperature strain grows best at about 39C.

Plants in space vehicles can be illuminated either with solar radiation or a fluorescent-incandescent lamp system operating on the space vehicle secondary power system. Solar radiation must be filtered to eliminate the lethal portion of the ultraviolet band and the infrared band. Intensity of solar radiation must be reduced from about 20,000 ft.-candles to about 5,000 ft.-candles. Lamp illumination for plants in the closed ecological system is promising because of the ease with which the emission spectrum of the lamps can be controlled. The short light-dark cycles of fluorescent lamps appear to be a satisfactory substitute for the diurnal cycles experienced by earthbound plants.

Much research remains to be done into fluorescent-incandescent systems as plant responses are not completely understood and the ratio of power input to light output is unacceptably low.

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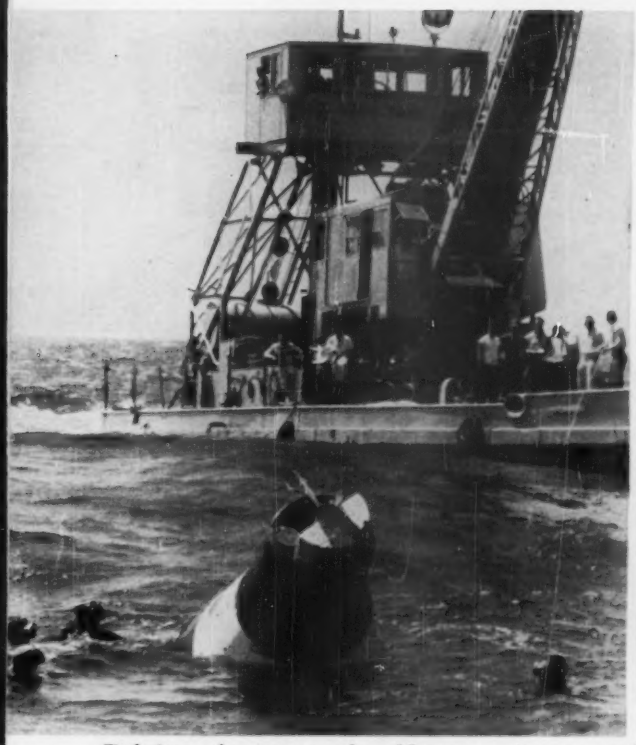


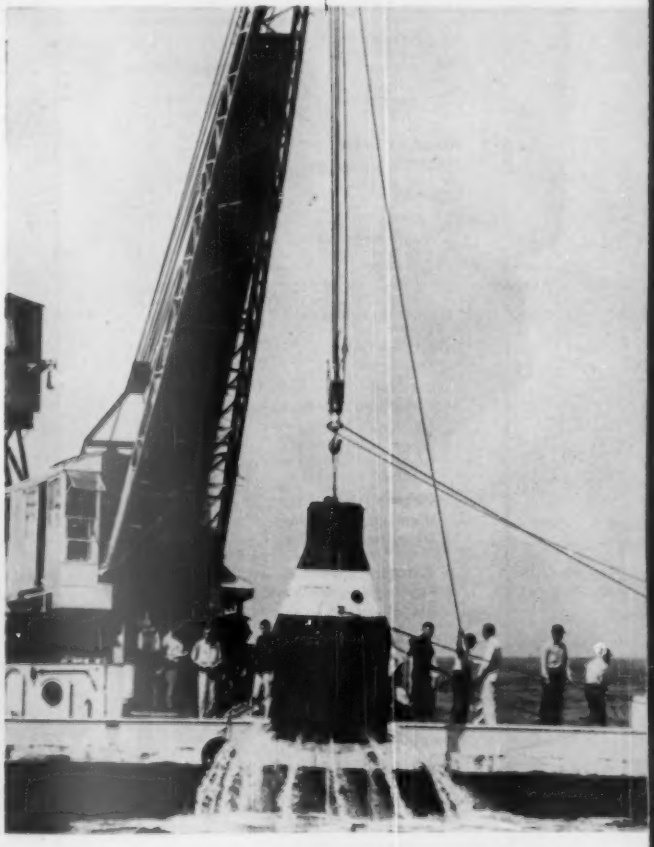
Techniques of water escape from Mercury man-in-space capsules are checked out at Pensacola, Fla., Naval Air Station by seven Mercury space pilots. Above, the pilot pushes extra parachute out of the way as he crawls toward opening.

Navy Skin Divers Aid Project Mercury Pilots in

Navy barge carrying technicians and rescue equipment stands by as the space pilot begins to free his life raft from the capsule (left). In photo at right, the pilot is being aided by the Navy skin diver as his life raft floats nearby.

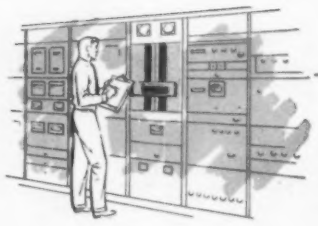
Navy skin diver helps position the capsule by means of a handling strap as the pilot emerges (left). This is considered the trickiest phase of escape. Note parachute floating away at right of photo. Capsule is being rotated by skin divers at right.

Water Escape System Tests



Skin diver helps control capsule movement by the handling strap (left) as the pilot moves away from the capsule toward his still uninflated life raft. At right, the Mercury capsule is hoisted aboard the barge; air bag on blunt end helps stabilize capsule.

the pb 250 / a general purpose,



The design of the PB 250 enables it to be mounted as a systems component in 31½ in. of a standard relay rack.

SPECIFICATIONS

TYPE
Serial, binary, internal program

COMMAND STRUCTURE
Single address with index register

NUMBER OF COMMANDS
46

OPERATION TIMES

Add/subtract	12 microseconds
Multiply	276 microseconds (max.)
Divide	252 microseconds (max.)
Square root	252 microseconds (max.)
Average access time	1,540 microseconds
Average access time to fast memory	96 microseconds
Maximum operational rate	40,000 instructions per second

WORD LENGTH
21 bits plus sign

MEMORY

Type:
Magnetostrictive delay lines

Capacity:
1,808 words (Up to 15,888 words internal storage at additional cost. 16,384 words external core memory also available.)

INPUT-OUTPUT

Standard:
Automatic alphanumeric typewriter
Paper tape punch and reader
32 control outputs
30 control inputs
High-speed block input-output (85 KC word rate)

Optional:
High-speed paper tape punch and reader
Magnetic tape units (six maximum) employing IBM 700 series format
Punched card equipment
Analog-to-digital converters
Digital-to-analog converters

PHYSICAL DESCRIPTION
30 in. high, 19 in. wide, 24 in. deep
110 pounds
Fully solid-state construction
Completely modularized

POWER REQUIREMENT
115 volts, 60 cycles, at 100 watts

Completely Solid State Internally-Stored Program

From Packard Bell Computer comes the first truly "second-generation" medium-scale computer. The PB 250 is a general purpose digital computer that may be applied to an extremely broad range of scientific, industrial, and military problems. The PB 250 combines a large, expandable memory and a versatile command structure with a computing speed in the microsecond range.

A FEW OUTSTANDING FEATURES OF THE PB 250

MICROSECOND SPEED

Computing speeds of the PB 250 rival those found only in expensive, large-scale systems. Addition and subtraction require 12 microseconds. Multiplication and division are variable length commands requiring 276 and 252 microseconds, maximum, respectively. All floating point operations require less than three milliseconds.

EXPANDABLE MEMORY

Minimum memory capacity of the PB 250 is 1,808 words, including one 16-word fast access line. The memory is economically expandable to 15,888 words internally, plus 16,384 words of external core storage.

VERSATILE COMMAND STRUCTURE

The extensive command list of 46 instructions contains 14 data transfer commands, 8 arithmetic commands (including divide and square root), 14 logical and program transfer commands, and 10 input-output commands.

SIMPLE PROGRAMMING

Programming simplicity is achieved by single-address instructions, command indexing, and automatic double precision operations. Symbolic programming routines are supplied at no extra cost with the PB 250.

FLEXIBLE INPUT-OUTPUT SYSTEM

The PB 250 is adaptable to a wider range of peripheral equipment than any computer in the low-priced field. This equipment includes high-speed tape readers and punches, magnetic tape units, card readers and punches, printers, analog-to-digital and digital-to-analog converters. Standard equipment includes an automatic typewriter, paper tape reader, and punch.

EXCEPTIONAL RELIABILITY

Maximum reliability is achieved through conservative solid-state design, a small component count (less than 350 transistors), and absence of moving parts.

All memory operations are parity checked.

SYSTEMS INTEGRATION

Flexible input-output design enables the PB 250 to be easily integrated into existing systems, either on- or off-line.

The PB 250 may operate as a universal format-to-format converter.

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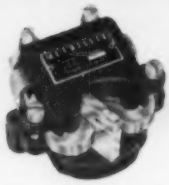
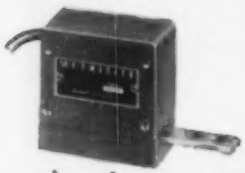
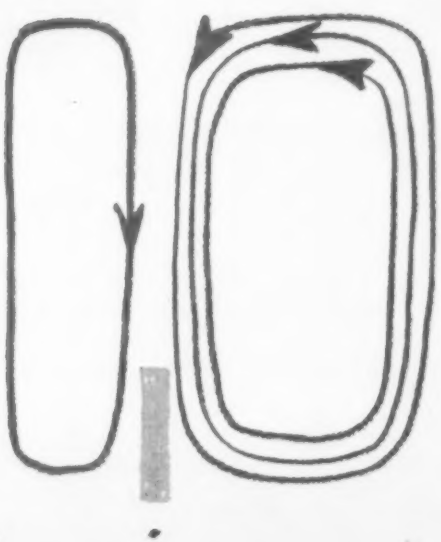
Metrisite... is the only  device available today that provides a near-perfect combination of ideal transducer characteristics. The unusual properties of this remarkable new motion-sensing development are: extreme resolution...  easily measures one ten-millionth of an inch; minute operating force... absolute minimum bearing friction; negligible reactive force... a fraction of a milligram; true linearity... a proven accuracy of 1/10%; high electrical output... up to 100 volts without amplification; wide range of shapes and sizes... from sub-miniature on up; exceptional ruggedness... can meet military shock and vibration tests. Now, many of the obstacles that have plagued control technology can be eliminated. Write for Metrisite details.



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Lockheed Model 60 Type-Certificated

By Richard Sweeney

Marietta, Ga.—Lockheed-Azcarate LASA 60 single-engine light utility plane has been awarded an FAA normal category approved type certificate for one of the two versions in which it will be offered. The plane was designed to operate from short and unimproved airstrips at high altitudes and temperatures, which make it suitable for Mexico and other Latin American countries (AW Nov. 23, p. 33).

Operational specifications were laid down by Gen. Juan Azcarate, Mexican aviation pioneer and director-general of Lockheed-Azcarate SA, the firm which at San Luis Potosi, 200 mi. north of Mexico City.

Two prototypes have been built. The FAA certificate was issued for the version of the airplane which uses a Continental IO-470 fuel injection engine rated at 250 hp. for sea level takeoff. The other prototype will be certificated soon in the alternate configuration offered, which will use a Continental TSIO-470 turbo-supercharged fuel injection engine rated at 260 hp. for sea level takeoff. With the supercharged engine, takeoff power rating and airplane performance is retained to altitudes well above sea level.

Using the supercharged engine, the plane has a top speed of 165 mph. at 10,000 ft. altitude. Effect of the supercharging, which is controlled automatically, shows in the aircraft's climb rates —930 fpm. at sea level, 800 fpm. at 12,000 ft. At normal takeoff gross weight of 3,532 lb., sea level takeoff distance over a 50-ft. obstacle is 1,045 ft., while at 8,000-ft. altitude, the takeoff run is 1,400 ft.

Plane is all metal, semi-monocoque construction, with a single-strut high wing which has an aspect ratio of 7.36, and incorporates manually controlled Fowler flaps. Fixed tricycle gear has the two main struts made of tapered steel tubes which are swept back 45 deg. from the fuselage attach points and are individually pivoted on rubber-snubbed trunnion plates. Steerable nose gear also is swept back, at the fork, for impact absorption. Plane also will be offered with floats or skis.

Cabin design provides for a six-place configuration which is readily convertible to the cargo or aerial ambulance mission. Regular passenger door is used on left side, while on the right a 4.5 ft.-wide door is used to accommodate

Lockheed Model 60 Design Data

Performance:		
Takeoff weight normal		3,532 lb.
Takeoff weight alternate CAR Part 8		3,752 lb.
Takeoff distance over 50 ft./sea level		1,045 ft.
Takeoff distance over 50 ft./7,000 ft		1,350 ft.
Rate of climb/sea level		930 fpm.
Rate of climb/10,000 ft		820 fpm.
Service ceiling standard day		23,100 ft.
Maximum speed/sea level		150 mph.
Maximum speed/10,000 ft		165 mph.
Maximum speed/15,000 ft		167 mph.
Range with reserves		550 mi.
Landing weight normal		3,232 lb.
Landing distance from 50 ft		1,045 ft.
Stalling speed		53 mph.

(Above data based on 260 hp. TS-IO-470 turbo-supercharged Continental engine at 3,532 lb. takeoff weight. The TS-IO-470 Continental fuel injection turbo-supercharged engine is a new powerplant now in the process of being certificated.)

Dimensions:		
Outside:		
Wing span		39 ft. 4 in.
Wing area		210 sq. ft.
Flap area		40 sq. ft.
Aileron area		23.5 sq. ft.
Total height		10 ft. 8 in. (tail)
Height to trailing edge (wing)		6 ft. 7 in.
Airplane length		28 ft. 1 in.
Tread		9 ft. 4 in.
Wheel base		6 ft. 9 in.
Propeller diameter		7 ft. 2 in.
Propeller ground clearance		1 ft. 8 in.
Inside: cabin useful volume		120 cu. ft.
Cabin length		11 ft. 10 in. (firewall to aft bulkhead)
Maximum height—cabin		4 ft. 3 in.
Maximum width—cabin		4 ft.
Spacing—six seats		2 ft. 4 in.
Cargo door (right side)		4 ft. 7½ in. W x 3 ft. 6 in. H (inside)
Passenger door (left side)		2 ft. 1½ in. W x 3 ft. 6 in. H (inside)

Characteristics:		
Weight empty		2,024 lb.
Useful load normal		1,508 lb.
Includes 60 gal. fuel @ 6 #	360	
Includes pilot	170	
Includes trapped fuel, oil, etc	30	
Payload normal	938 lb.	
Gross takeoff weight normal (CAR Part 3)		3,532 lb.
Gross takeoff weight CAR Part 8 (Alternative)		3,752 lb.

Powerplant and Propeller:

Engine:

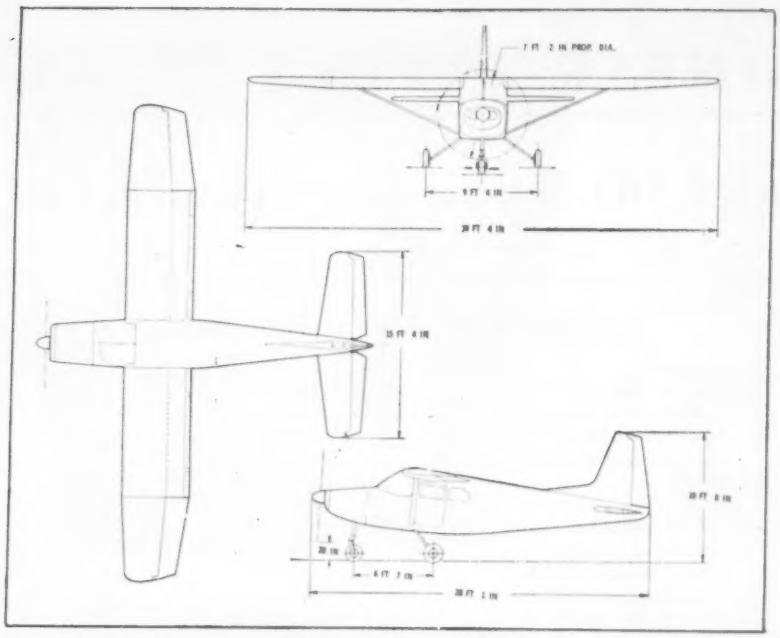
Continental TS-IO-470 fuel injection, turbo-supercharged—260 hp. (100/130 oct.)

Alternative:

Continental IO-470 fuel injection—
250 hp. (91/96)
260 hp. (100/130)

Propeller:

McCauley, controllable-pitch, all-metal



THREE-VIEW of LASA 60 shows single-strut high wing which has an aspect ratio of 7.36, and incorporates manually-controlled Fowler flaps. Fixed tricycle gear has two main struts made of tapered steel tubes which are swept back 45 deg. from fuselage attach points and are individually pivoted on rubber-snubbed trunnion plates. Steerable nose gear is also swept back, at the fork, for impact absorption. Aircraft is of all metal, semi-monocoque construction. Cabin contains 120 cu. ft. of space, is 11 ft. 10 in. long, 4 ft. 3 in. high and 4 ft. wide. Design provides for a six-place configuration which is readily convertible to cargo or aerial ambulance mission.

bulky cargo loading and unloading. Both doors are 3.5 ft. high.

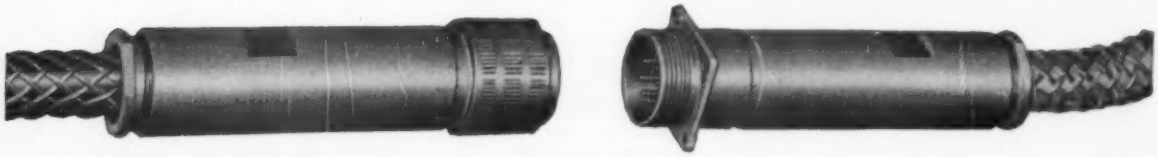
Cabin contains 120 cu. ft. of space, is 11 ft. 10 in. long, 4 ft. 3 in. high and 4 ft. wide. Floor is stressed for concentrated loads from cargo, and seats can be stowed and carried aboard while plane is performing alternate missions.

First production model of the LASA 60 is due to roll off the San Luis Potosi production line in October. During prototype construction, 10 Mexican engineering and technical people participated in the program in Georgia to form the nucleus for production supervision in San Luis Potosi.

Under terms of the contract between Lockheed-Azcarate SA and Lockheed Aircraft Corp.'s Georgia Division, two certificated prototype airplanes will be delivered to LASA, along with a manufacturing package which includes factory layout and equipment specifications for the Mexican plant, all factory tooling and procedures plus a master scheduling and manufacturing plan. Plane's design is such that fabrication can be done with minimum skilled labor.

Original preliminary LASA 60 design was done by Lockheed's California Division at Burbank, although the project later was transferred to the Georgia Division.

Lockheed-Azcarate is composed of a



Why it pays you to specify

Bendix QWL Electrical Connectors for use with Multi-conductor Cable

For use with multi-conductor cable on missile launching, ground radar, and other equipment, the Bendix* QWL Electrical Connector meets the highest standards of design and performance.

A heavy-duty waterproof power and control connector, the QWL Series provides outstanding features: • The strength of machined bar stock aluminum with shock resistance and pressurization of resilient inserts. • The fast mating and disconnecting of a modified double stub thread. • The resistance to loosening under vibration provided by special tapered cross-section thread design. (Easily hand cleaned when contaminated with mud or sand.) • The outstanding resistance to corrosion and abrasion of an aluminum surface with the case hardening effect of Alumilite 225 anodic finish. • The firm anchoring of cable and effective waterproofing provided by the cable-compressing gland used within the cable accessory. • The watertight connector assembly assured by neoprene sealing gaskets. • The additional cable locking produced by a cable accessory designed to accommodate a Kellems stainless steel wire strain relief grip. • Prevention of inadvertent loosening insured by a left-hand accessory thread. • The high current capacity and low voltage drop of high-grade copper alloy contacts. Contact sizes 16 and 12 are closed entry design.

These are a few of the reasons it will pay you to specify the Bendix QWL electrical connector for the job that requires exceptional performance over long periods of time. *TRADEMARK

Export Sales and Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y. Canadian Affiliate: Aviation Electric Ltd., 200 Laurentien Blvd., Montreal 9, Quebec. Factory Branch Offices: Burbank, Calif.; Orlando, Florida; Chicago, Ill.; Teaneck, New Jersey; Dallas, Texas; Seattle, Washington; Washington, D. C.

Scintilla Division
Sidney, New York

Bendix
AVIATION CORPORATION

Another Way
RCA Serves Science
Through
Electronics

THIS IS TIROS...

Experimental Weather Observer

This is TIROS—the world's most advanced television-equipped earth satellite. In one giant step it has extended man's powers of continued observation 400 miles into space. The pictures of cloud cover and wind patterns it is now sending down are a major contribution to the science of meteorology—bringing ever closer the day of improved, long-range weather analysis and forecasting.

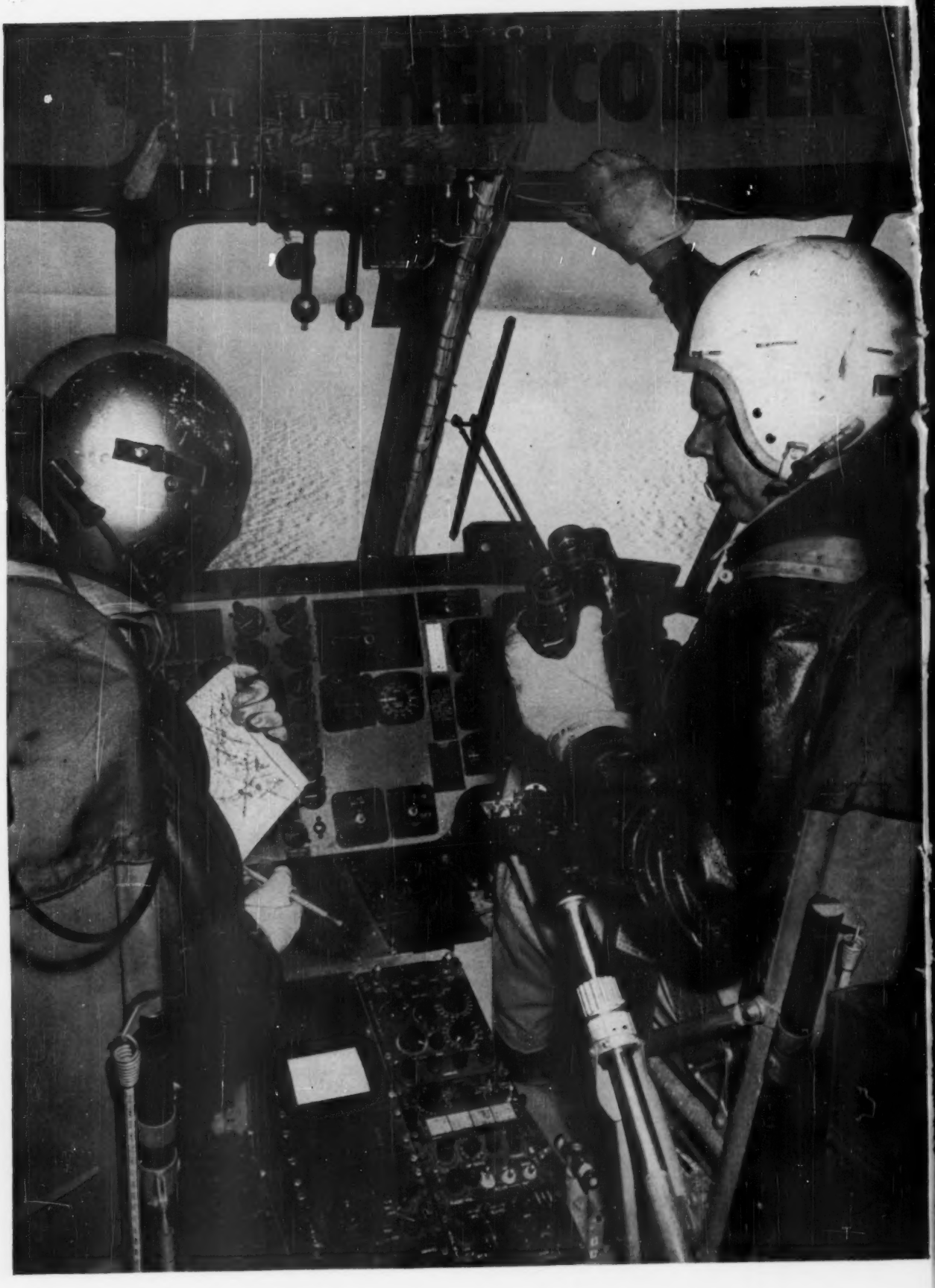
The entire TIROS satellite, its component systems and associated ground equipments were developed and built by RCA's Astro-Electronic Products Division for the National Aeronautic and Space Administration under the technical direction of the U. S. Army Signal Research and Development Laboratory. Included in the satellite are two TV cameras equipped with shutters so they can take still pictures, tape recorders to store the pictures when out of ground station range, TV transmitters, command receivers and timing clocks for function control, radio beacons and telemetry equipment, and numerous auxiliary devices to control satellite dynamics. Power is supplied by storage batteries recharged by an array of 9200 solar cells which convert the sun's energy into electricity.

Significant as it is, TIROS is a beginning, not an end. Future satellites and space probes will be far more complex. Yet they will grow out of the experience and capabilities in space electronics, satellite dynamics and structural loading techniques that made Project TIROS a reality. To find out how you can draw on this unique research and development capability, get in touch with the Marketing Manager, RCA Astro-Electronic Products Division, Princeton, N. J.

RADIO CORPORATION OF AMERICA

Astro-Electronic Products Division ***Princeton, N.J.***

Ground-based equipment and data processing techniques—another AEP capability.


HELICOPTER

WITH A HIGH IQ

With new Hamilton Standard flight control—combining autopilot, amplifier-coupler in one package—Sikorsky S-61 cruises, climbs *and* hovers "hands off"

An advanced flight control, designed and built by Hamilton Standard in cooperation with Sikorsky Aircraft, helps make the S-61 the "brightest" helicopter flying today. It is the first helicopter flight control to combine an autopilot and amplifier-coupler in one package, and gives the S-61 completely automatic control for any pre-set flight mode, plus automatic stabilization for all flight regimes—yaw, pitch, roll, or collective.

The unit itself is fully transistorized; employs redundant circuitry for reliability and has separate plug-in modules. Compact and lightweight, this new control is typical of the sound design and engineering that Hamilton Standard is applying to a variety of projects in the flight control field.

ADAPTIVE FLIGHT CONTROLS for re-entry bodies, space-probes and -gliders are now in advanced stages of study at Hamilton Standard. This program involves the development of a self-adaptive system that will not only compensate for aerodynamic changes, but will also compensate for failure of its own components.

MISSILE FLIGHT CONTROL. Hamilton Standard has also created a new concept in digital flight control and guidance systems for advanced missiles. This system offers significant reductions in weight and component complexity.

FLIGHT CONTROL is just one of the many areas of electronics in which Hamilton Standard is working today. The company's experience also includes instrumentation, electrical control, and static power conversion. These activities, plus the technologies developed in producing electronic controls for environmental conditioning systems, starters, turbine and rocket fuel controls, propellers, and ground support equipment, establish Hamilton Standard as a dependable source of widely diversified electronics capabilities.

FOR COMPLETE INFORMATION on how Hamilton Standard Electronics can go to work for you, phone or write: Hamilton Standard Electronics Department, 50 Main St., Broad Brook, Connecticut.

"CEREBELLUM" of the S-61's automatic stabilization and flight control system is this compact control unit, designed and built by Hamilton Standard. It has separate plug-in modules which are completely interchangeable in any of the four major channels. The control takes inputs from pilot command settings, flight parameter sensors, and sonar coupler signals. Error signals for yaw, pitch, roll, and collective pitch are computed and amplified to drive the craft's hydraulic flight-control actuators.

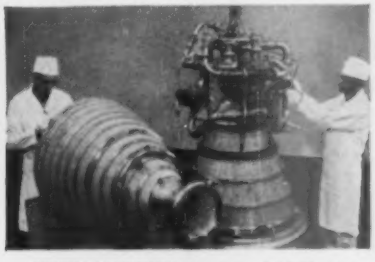
HAMILTON STANDARD

DIVISION OF UNITED AIRCRAFT CORPORATION

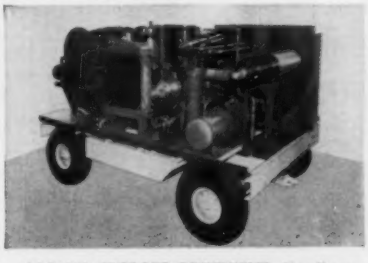
WINDSOR LOCKS, CONNECTICUT

SOME OF THE MANY FIELDS OF GROWTH AT HAMILTON STANDARD

ENVIRONMENTAL CONDITIONING SYSTEMS for space vehicles and such advanced aircraft as the B-58, B80, B-70 are important aspects of Hamilton Standard diversification.

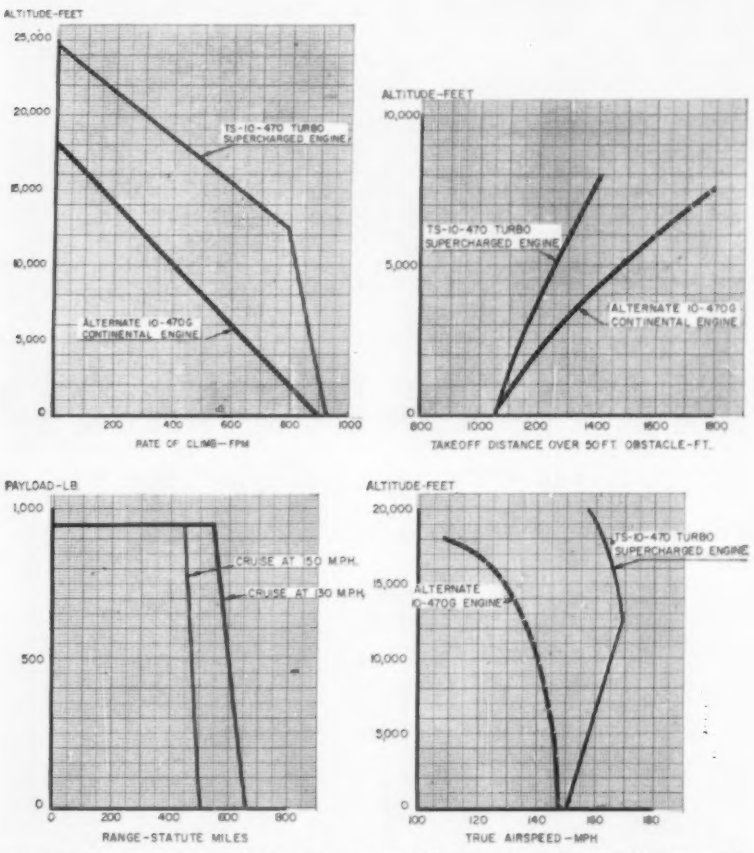


ENGINE CONTROLS for over 20,000 aircraft gas turbines have been produced by Hamilton Standard. The company's latest control work involves advanced rocket engines.



GROUND SUPPORT EQUIPMENT. Hamilton Standard is presently producing a wide range of GSE for both missiles and aircraft—from special tools to complete systems.

WIDE-VISIBILITY windshield and novel tricycle gear of Lockheed-Azcarate Model 60 are seen in above flight photo. Prototype of the six-place utility aircraft, already certificated by FAA, was built by Lockheed's Georgia Division. Production versions will be built at the new San Luis Potosi factory of Lockheed-Azcarate in Mexico, and in Italy by Aeronautica Macchi.



CHARTS show effect of 260-hp. Continental turbo-supercharged fuel injection engine, which gives LASA 60 a top speed of 165 mph. at 10,000 ft. altitude. With automatically controlled supercharger, aircraft climbs at 930 fpm. at sea level. Sea level takeoff distance over 50-ft. obstacle is 1,045 ft. at normal gross weight of 3,532 lb.

Mexican group, headed by Azcarate and Abelardo Rodriguez, former president of Mexico, and Lockheed Aircraft International (AW Mar. 28, p. 103). Lockheed Azcarate also has licensed Aeronautica Macchi in Italy, another LAI partner, to manufacture the LASA 60 in Europe.

PRIVATE LINES

Federal Aviation Agency has proposed a rule for uniform display of identification marks on aircraft. Proposal would require identification marks not less than 12 in. high on each side of the fuselage, and identification marks not less than 20 in. high on the left half of the lower wing surface. Change is suggested to improve both air and ground identification and would become effective one year after adoption of the rule.

Air Associates, Inc., has opened its 14th branch at the Houston, Tex., airport, President C. A. Sereno, Teterboro, N. J., announces. The firm handles more than 25,000 items of aviation supplies.

Fifth-seat kit for installation in baggage compartments of the Cessna 170, 172, 180 and 182 planes has been developed by Fulton Conversion Co., of Southbury, Conn. Seat can be folded to allow normal use of baggage compartment. Installed weight is 13 lb. and price is $195.

SOLVING MATERIAL DESIGN PROBLEMS
HEAT RESISTANCE
A 5000° flame has not penetrated a one-quarter-inch piece of CDF's new Dilecto RD-105 laminate after ten minutes. The same thickness of cold-rolled steel is pierced in less than forty seconds.

Molded from graphite fabric impregnated with a heat (ablation)-resistant phenolic resin, new CDF grades RD-105 and RD-115 are being evaluated in solid propellant rocket motors.

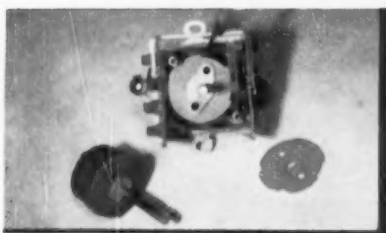
Dilecto laminates are only one family of products from industry's largest selection of non-metallic structural materials and electrical insulations. Vulcanized fibre, silicone rubber, mica, Teflon*, and thermosetting moldings are also supplied by CDF.

CDF can provide both quality and true economy in selecting plastic materials best suited to your needs. Refer to SWEETS PD file or write to us for General Folder 60.

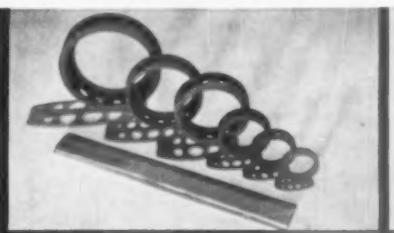
*DuPont trademark

CONTINENTAL-DIAMOND FIBRE

A SUBSIDIARY OF THE Budd COMPANY • NEWARK 19 DEL.



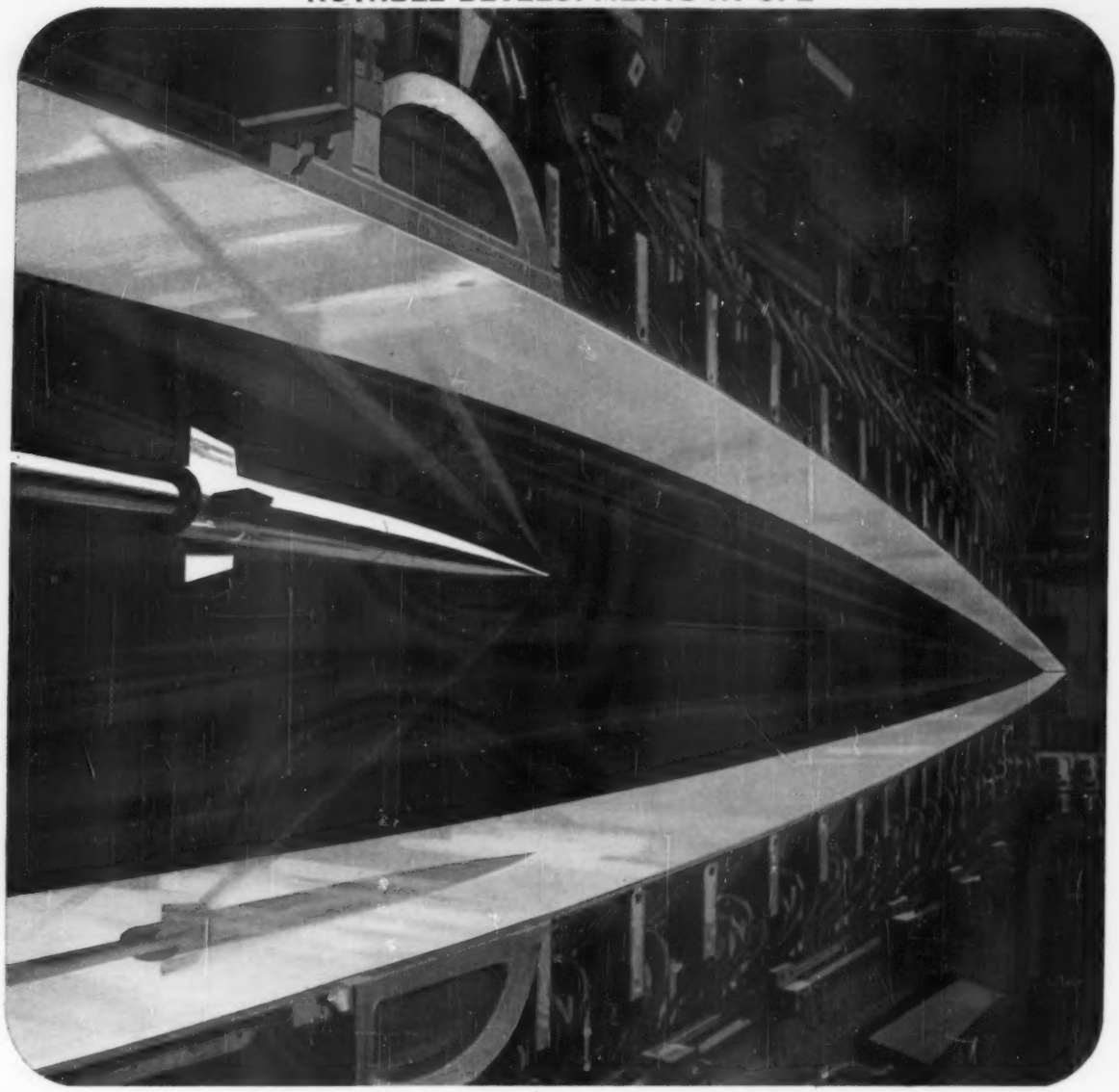
Moisture-resistant and low cost Dilecto cams for automatic washer and dryer controls.



Dimensionally stable, light weight, oil-resistant Dilecto ball bearing retainer rings.

Easily fabricated paper-base, punching grade Dilecto precision switch insulators.

NOTABLE DEVELOPMENTS AT JPL



HYPERSONIC WIND TUNNEL

One of the latest research facilities at the Jet Propulsion Laboratory is the recently completed, continuous-flow hypersonic wind tunnel. Developed by the Lab, this new tunnel generates air speeds up to ten times the speed of sound. Its 21-inch square test section provides accommodation for models up to four feet long thus permitting increased model instrumentation. This large test section at Mach 10 with a continuous uniform air flow broadens JPL capabilities in the important area of fluid dynamic research.

To minimize structural deflections due to temperature changes and thus the time required to reach equilibrium conditions, the entire tunnel structure is water cooled and housed in an air conditioned building. Any Mach number between five and ten can be precisely set by means of flexible stainless steel nozzle plates that are positioned to a ten-thousandth of an inch. Calibration results indicated satisfactory solution of the design problems encountered.

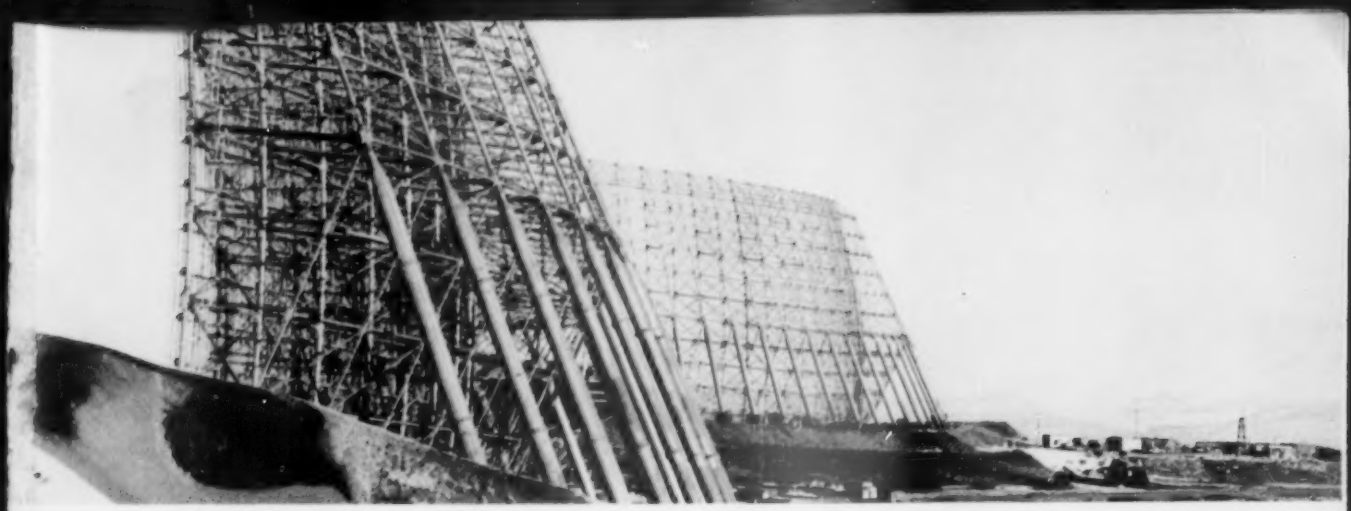
The high speed data-acquisition, reduction, and presentation system is designed for high production testing of the nation's most advanced missiles and re-entry configurations. Stability and control phenomena in new regimes can be studied experimentally under carefully controlled conditions.

CALIFORNIA INSTITUTE OF TECHNOLOGY
JET PROPULSION LABORATORY
A Research Facility operated for the National Aeronautics and Space Administration
PASADENA, CALIFORNIA

Employment opportunities for Engineers and Scientists interested in basic and applied research in these fields:

INFRA-RED • OPTICS • MICROWAVE • SERVOMECHANISMS • COMPUTERS • LIQUID AND SOLID PROPULSION • STRUCTURES • CHEMISTRY • INSTRUMENTATION • MATHEMATICS • AND SOLID STATE PHYSICS •

Send professional resume, with full qualifications and experience, for our immediate consideration



Professional placement report
for Electronics Engineers

How the continuous need to improve the nation's space surveillance capabilities opens avenues for new engineering careers

The continuous need we are talking about at General Electric refers to the fact that future-generation missiles, satellites and deep space probes will require refined or entirely new detection techniques, including many that have not yet been conceived.

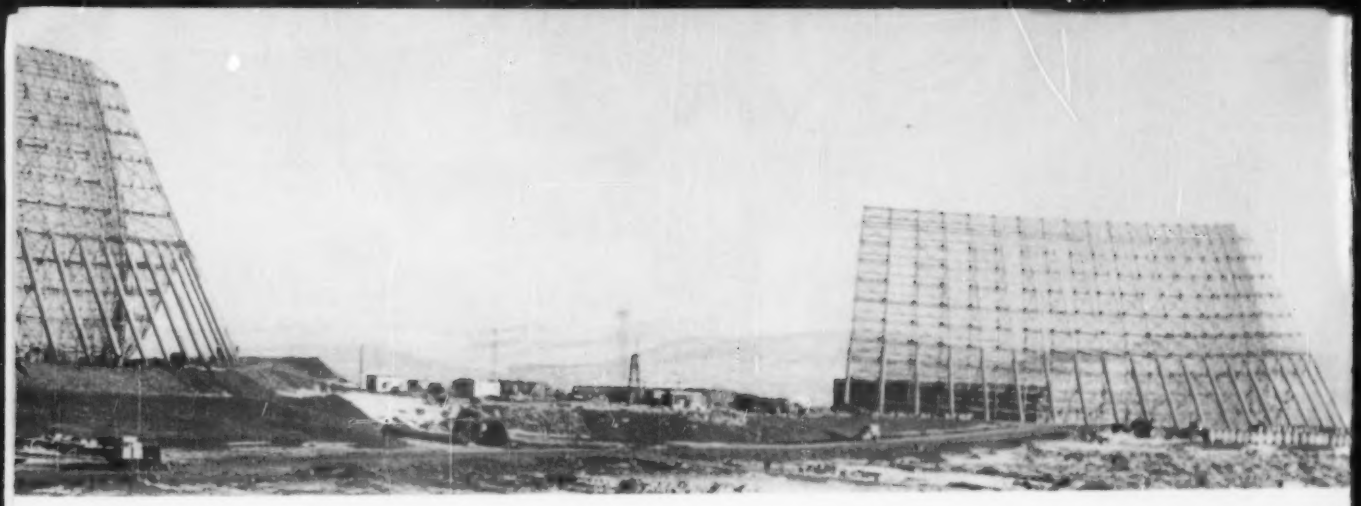
For example, it is anticipated that for every technical discipline now utilized in the detection field, at least one more must be found to apply within the next 10-year period.

With this in mind, General Electric is increasing its electronics engineering staff now working on advanced missile, satellite and deep-space-probe detection systems. Keeping pace with this expansion, the Company added a new building last year, and another will be ready for occupancy in a few months.

First clues to this trend were obvious in General Electric's well known "Golfball Study," published five years ago. This study compared the problem of missile detection to that of locating a golfball 200 miles away, using the most advanced techniques available in 1954. The problem no longer has such proportions, thanks to the creative imagination of dedicated General Electric engineering, scientific, and technical personnel responsible for designing and developing the unique surveillance sub-system of the Ballistic Missiles Early Warning System (BMEWS) which is receiving headline attention today.

Find out more about these creative and self-expressive opportunities now open to qualified personnel in one of the most vital technologies of the space age.

GENERAL ELECTRIC



Immediate openings for qualified electronics engineers

RADAR EQUIPMENT SYSTEMS SPECIALISTS capable of conceiving and directing the design of long-range radar systems. Desirable experience includes 3 to 10 years in at least one of the following: radar systems design, antenna systems, RF components, transmitters, radar receiver systems or radar data processing systems. Salary structure is fully equal to the professional requirements of the job.

ADVANCED SYSTEMS ENGINEERS capable of defining future defense and space detection problems including deep space-probe tracking. Also the ability to conceive and establish the feasibility of optimum systems solutions to these problems—making use of the most advanced techniques and understandings. Also required is an ability to recognize the need for, and coordinate the development of, new techniques and the exploration of new phenomena. Experience requirements include a Bachelor degree plus a combination of advanced training and several years' experience in both the theoretical and practical aspects of detection systems engineering. A desire to work in the conceptual phase of systems design with the analytical ability required to evaluate and demonstrate the effectiveness of the proposed systems is essential.

FIELD OPERATIONS ENGINEERS for systems management teams to be deployed at complex radar systems installations of the BMEWS type. Systems-oriented Electronics Engineers are needed who have the ability to assume responsibility for installation, checkout, and integration of major radar systems. Background in high-powered Klystron transmitters, low-noise receivers and digital data processing equipment is desirable. A Bachelor degree is required.

ADDRESS YOUR INQUIRY IN CONFIDENCE TO:
MR. JOSEPH WOOL, PROFESSIONAL PLACEMENT, DEPT. T-1
MISSILE DETECTION SYSTEMS SECTION
HEAVY MILITARY ELECTRONICS DEPARTMENT
GENERAL ELECTRIC COMPANY
COURT STREET, SYRACUSE, NEW YORK

Qualified applicants will be invited to visit us in Syracuse at Company expense. Relocation assistance will be provided. 177-25

GENERAL ELECTRIC

HEART of Federal Aviation Agency's new semiautomatic traffic control data processing system is this Librascope digital computer, one of four on order, which now is undergoing initial tests at FAA's National Aviation Facilities Experimental Center in Atlantic City.

FAA Checks Automated Traffic Controls

By Philip J. Klass

Atlantic City, N. J.—First digital computer developed specifically for air traffic control is now undergoing shakedown tests here by the Federal Aviation Agency at its National Aviation Facilities Experimental Center (NAFEC).

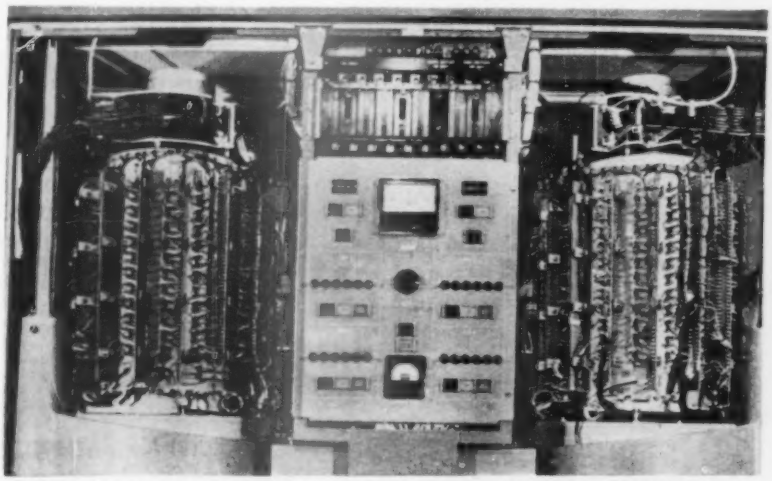
Additional elements of the data processing system aimed at semiautomatic traffic control will be delivered during the next several months. By midsummer FAA will start debugging the functional aspects of its computer traffic control programing and by early next year it expects to begin initial full-system tests on real-time traffic control problems.

The computer now under test is the first of four to be delivered. It was produced by Librascope, a division of General Precision, Inc., for a sister division, General Precision Laboratory, which is prime contractor to the FAA on the new data processing system.

The new data processing system is expected to relieve human traffic controllers of much of the routine clerical and bookkeeping operations, freeing them for important decision-making functions.

The Librascope computer, which is fully transistorized, will perform the following functions in the system:

- **Store flight plans.** As presently designed, the computer can store up to 1,000 flight plans.
- **Compute check point ETA.** From filed flight plans, the computer will calculate each aircraft's estimated time of arrival over every check point along the route and initiate signals to print out new or revised flight progress strips for each traffic controller as he requires it. The computer can process up to 440 flight plans per hour and print up to



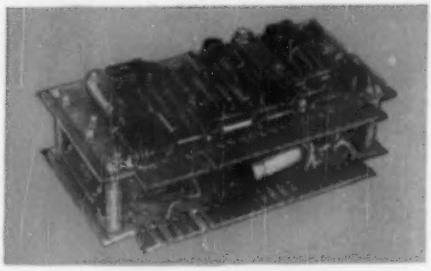
CLOSEUP of Librascope computer, which can accommodate 16 file drums like those shown. Each drum has a capacity of 16,000 eight character words, thus providing a total maximum capacity of 256,000 words.

TAPCO ANALOG COMPONENTS

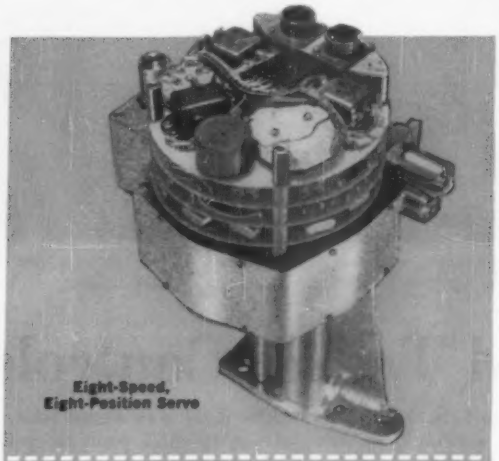
For airborne equipment

TAPCO analog components have been proved in various classified aircraft and missile applications. The TAPCO line includes:

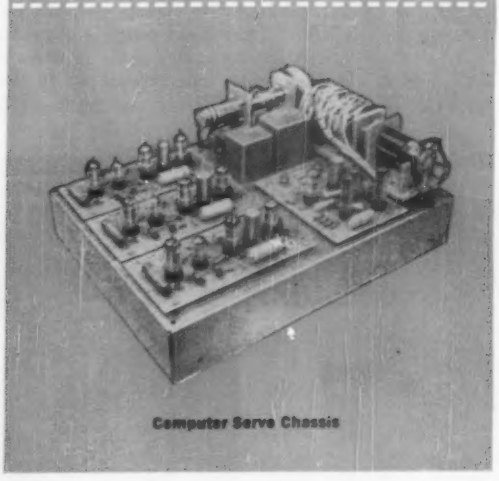
- Position Servos
- Velocity Servos
- Miniaturized Servo Amplifiers
- Tracking Computers
- Data Conversion Units
- Arithmetic Computers



Transistorized Servo Amplifier



Eight-Speed, Eight-Position Servo



Computer Servo Chassis

PERFORMANCE DATA: TRANSISTORIZED EIGHT-SPEED SERVO (Illustrated at left)—**Speed Range:** From 1 to 2.5 rpm. **Speed Tolerance:** ±0.2% over temperature range of 50°F to 85°F. **Angular Vibration Tolerance:** 5 x 10^{-5} radians double amplitude. **Acceleration:** Zero to maximum speed within 0.2 seconds. **Transition time:** Speed change time within 0.1 seconds. **Torque Output:** 100 oz. in. with 15 watts input. Higher torque available with increased power consumption. **Power Requirements:** 10.0 watts steady rate. 18 watts peak during acceleration or speed change. **PHYSICAL DATA—Size:** 10¼" x 7¾" x 8½". **Weight:** 5¼ lbs.

For ground support equipment

All TAPCO GSE analog computer components use MIL-approved parts for highest reliability. Modular construction of these components allows compact assembly on chassis. The TAPCO line includes: DC Operational Amplifiers, Servo Amplifiers, Buffer Amplifiers, Electronic Modulators, Position and Rate Servos, Vector Servos, Aircraft Dynamic Simulator, Coordinate Converters, Special Multipliers and Dividers, Ballistic Computer.

PERFORMANCE DATA: DC OPERATIONAL AMPLIFIER—Gain: 10^6 open loop at 0.01 cps. **Drift:** Less than 100 micro-volts. **Linearity:** ±.1% of input voltage. **Input Power:** 25 watts. **Output Voltage:** ±85 V DC—50K Load, ±40 V DC—8K Load. **Noise:** Less than 100 micro-volts. **PHYSICAL DATA—Size:** 4" x 8⅜" x 2½". **Weight:** 9 oz.

PERFORMANCE DATA: AC SERVO AMPLIFIER—Gain: Open loop 60,000. **Gain:** With external feedback 10,000. **Input Impedance:** Greater than 1 megohm. **Frequency Response:** To 40 cycles. **Input Power:** Approx. 40 watts. **Output Power:** Approx. 6 watts. **High Impedance Servo Motor Output. PHYSICAL DATA: Size:** 5" x 7" x 3⅜". **Weight:** 11 oz.

For further information, write on your company letterhead indicating your specific product interest.

TRW

TAPCO GROUP

Thompson Ramo Wooldridge Inc.

DEPT. AW-460 • CLEVELAND 17, OHIO

DESIGNERS AND MANUFACTURERS FOR THE AIRCRAFT, MISSILE AND SPACE, ORDNANCE, ELECTRONIC AND NUCLEAR INDUSTRIES

1,600 progress strips per hour.

• **Conflict detection.** The computer will analyze each flight plan when filed, or as subsequently revised, for possible conflict with other aircraft flight plans already on file and automatically alert the traffic controller, displaying the potential conflict situation if desired.

• **Arrival-departure sequencing.** The computer will determine optimum sequence of arrival for inbound aircraft, at rates up to 90 aircraft per hour, and simultaneously monitor departure of out-going aircraft at the same rate.

The FAA/GPL decision to retain the use of flight progress strips was based on the desire to permit an evolutionary transition from present manual traffic control techniques and to assure continuity of traffic control functions in the event the data processing system should break down.

The Librascope data processor incorporates many techniques intended to prevent errors in the automatic processing of traffic control data. These include:

• **Duplicate storage** of flight plans to prevent loss of flight plan information and to provide a cross-reference for accuracy checks.

• **Duplicate arithmetic unit** simultaneously performs each calculation twice, compares the results to be sure they are identical.

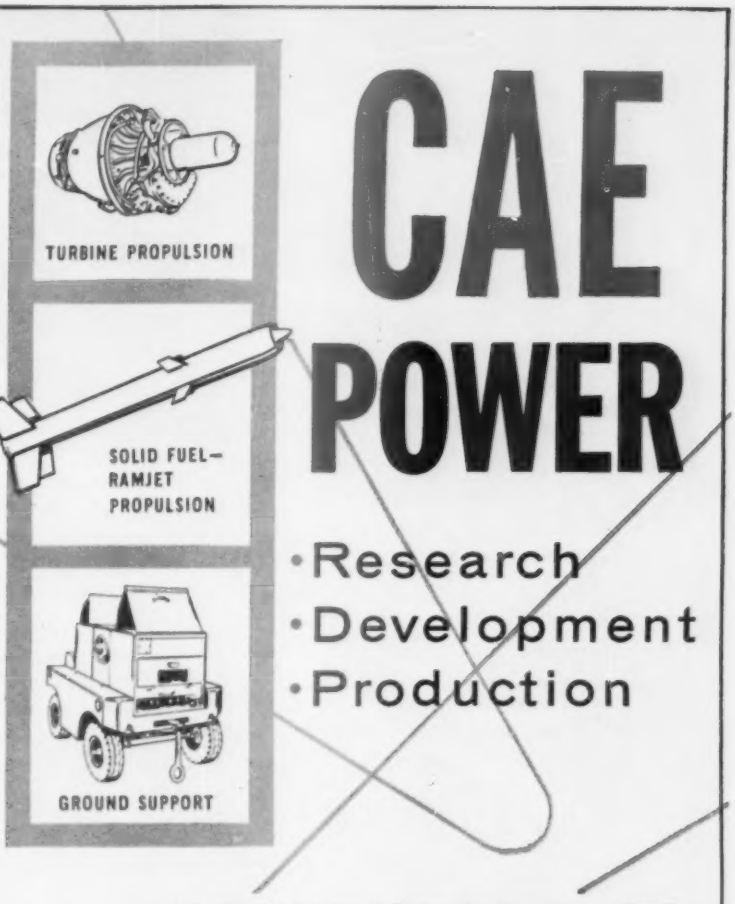
• **Parity check** is performed on each "word" to be sure there has been no loss of pulses, causing an error.

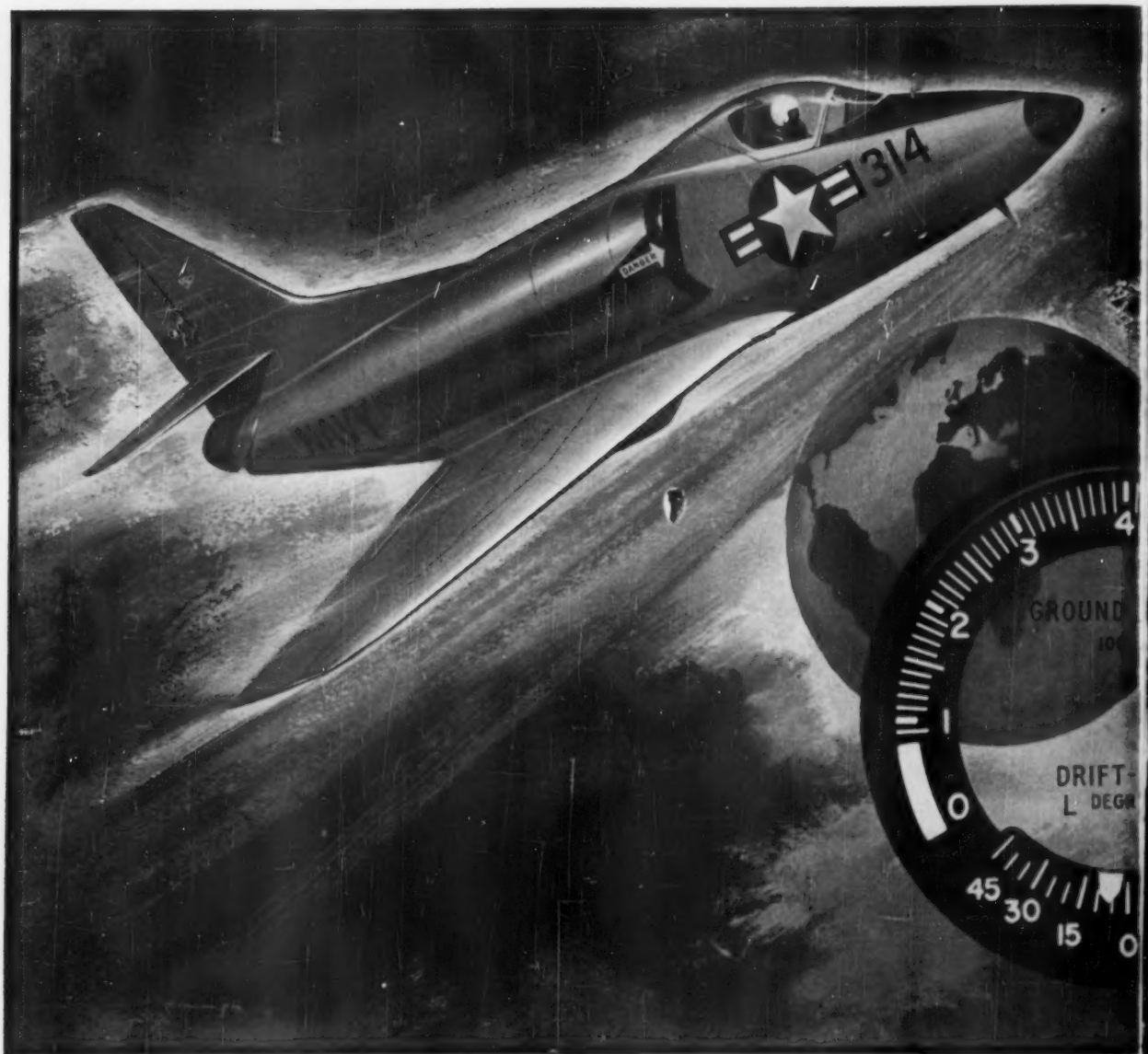
• **Marginal checking** of data processor's circuits is performed at regular intervals to permit detection of those whose performance has deteriorated before the degradation reaches a point which would cause failure.

Flight plans can be entered into the data processor by the traffic controllers using special keyboard units or by teletype lines from other traffic control centers, SAGE air defense computers, or airline dispatchers. The controller's keyboard unit automatically arranges the information into the format required by the data processor. Accessory units will check teletype messages for correct content and format before entering them into the data processor.

Because flight plan data from other traffic control centers, SAGE computers or airline dispatchers comes in by teletype at a slower rate than the computer can accept, and because the computer can spew out its calculated information at a faster rate than it can be handled by teletype lines and by print-punch units, a buffer storage is used to transfer data between computer and input-output devices at their own data speeds.

Slow-rate incoming data is stored in the buffer drum from which it subsequently is transferred into the computer at the latter's high data rate. Similarly,


TURBINE PROPULSION
SOLID FUEL–
RAMJET
PROPULSION
GROUND SUPPORT
CAE
POWER
•Research
•Development
•Production
•Continental Aviation & Engineering Corp. is exceptionally well qualified, both by experience and by facilities, for work on the weapons systems of tomorrow. Our background embraces not only a half-century of internal combustion engine experience, but also years of pioneering in gas turbine engine development, and more than a decade in the field of solid fuels for ramjet propulsion of missiles and target drones . . . Continental is staffed and equipped for a wide range of assignments, military and commercial. The Detroit Division Research and Development Department is supported by our modern-to-the-minute Component Testing Laboratory complete with environmental facilities located at Toledo. The Toledo Production Division now producing various turbine engines in volume is capable of supporting diversified programs . . . The CAE record of achievement is one of which many a larger company might be proud. Inquiries are invited from those having propulsion problems, on the ground, on the water, in the air.
CONTINENTAL AVIATION
CONTINENTAL AVIATION & ENGINEERING CORPORATION
GENERAL OFFICES AND RESEARCH AND DEVELOPMENT DEPARTMENTS AT 12700 KERCHEVAL AVENUE, DETROIT 15, MICHIGAN . . . PRODUCTION DIVISION AND FIELD SUPPORT, 1330 LASKEY ROAD, TOLEDO, OHIO.
SUBSIDIARY OF CONTINENTAL MOTORS CORPORATION



ANTI-SUBMARINE WARFARE. Nearly all types of Navy ASW aircraft . . . helicopters . . . seaplanes . . . hunter-killer aircraft . . . blimps . . . are equipped with Ryan CW doppler radar systems which offer excellent and proven performance in many applications.

PINPOINTING MILITARY MISSIONS. Ryan CW electronic systems give new precision to navigation, bombing, photo-mapping, mine-laying and airborne-early-warning missions of the Navy and low-level, reconnaissance and troop-carrying missions of the Army.

Electronic Developments at Ryan Point to New Horizons for the Space Age

SPACE AGE electronic guidance systems can leave nothing to chance. In delicate maneuvers like space vehicle landings and vehicle-satellite rendezvous, near-absolute precision is vital. Within a few years . . . or perhaps even months . . . revolutionary new techniques and adaptations of existing techniques will be needed. Ryan Electronics is ready to help meet this need.

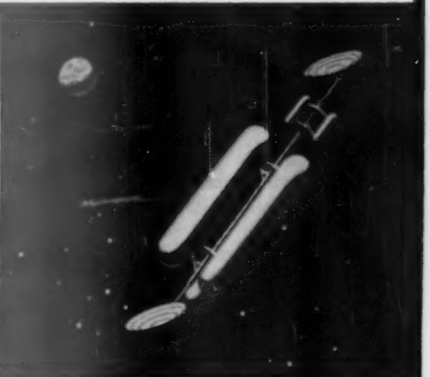
Ryan is the world leader in the design and manufacture of today's most advanced *proven* aerial navigation technique: CW (continuous wave) doppler radar. Ryanav* doppler systems are in use in many of our nation's most modern aircraft.

To serve America's expanding need for electronics, Ryan has doubled and redoubled its staff of electronics engineers and technicians and greatly expanded its modern research and production facilities since 1957. This is growth based on achievement.

This is Ryan Electronics.

*Trademark

JET AGE NAVIGATION. Widely used in large jet bombers, Ryan continuous wave doppler automatic navigation systems have now been tailored for use in small fighter and light attack aircraft. Now complete navigational capability, without wind-induced error or reliance upon information from ground stations, is possible for compact combat aircraft such as the Douglas A4D Skyhawk.



ADVANCED IFF. Ryan Electronics is designing advanced, lightweight IFF (Identification, Friend/Foe) radar systems for military aircraft. These embody the latest electronic packaging techniques.

SPACE NAVIGATION. Guiding astronauts through space, orienting space platforms, making "soft" landings on the moon are some of the problems of the future being solved today at Ryan Electronics.

Ryan's rapid growth in electronics is creating new opportunities for engineers

RYAN ELECTRONICS

DIVISION OF RYAN AERONAUTICAL COMPANY • SAN DIEGO, CALIFORNIA

RYAN BUILDS BETTER

engine power
BY CATERPILLAR

THEY DEPEND ON CAT DIESEL POWER TO KEEP AIR FORCE ATLAS MISSILE ON TARGET

Calibration of the delicate electronic system of an Atlas missile requires a portable power source with unusually accurate control of voltage.

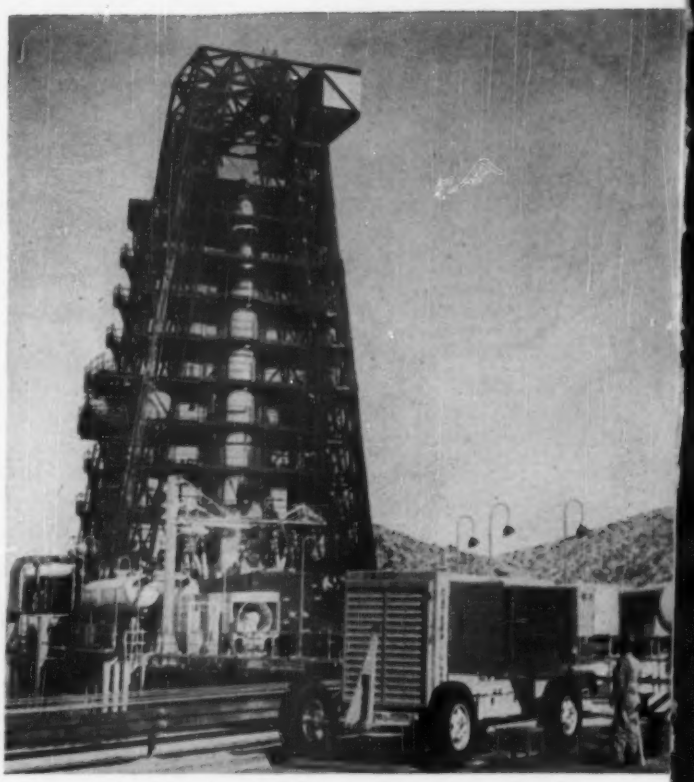
Down-range tracking stations need a power supply that can be depended upon in *any* emergency.

Both requirements are met by Caterpillar Diesel Electric Sets. Caterpillar Diesel Engines in these sets are extremely efficient 4-cycle engines which operate on any fuel from JP-4 through No. 2 furnace oil. They start easily, pick up load quickly and can be maintained and operated by unskilled personnel. Parts—and service—are available all over the Free World.

These are some of the reasons why you will see so many Caterpillar Electric Sets used for primary and standby power at our missile bases and other military establishments. They are used to supply power for testing, for starting jet engines, for radar warning systems, for lighting, heating and other base living facilities.

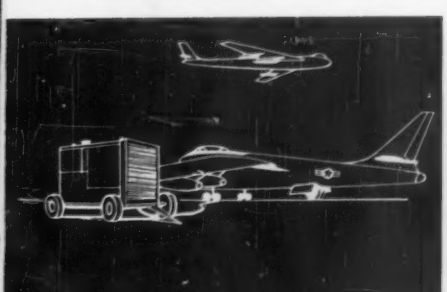
Free booklet. Get the full story on the advantages of Caterpillar Diesel Electric Sets. Write to Engine Division, Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

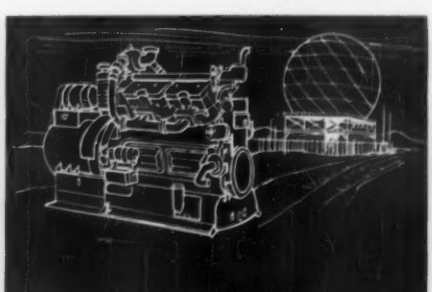


At Edwards Air Force Base in California, power for testing the precision electronic control circuits of the Atlas missile is supplied by two Cat D375 Diesel Electric Sets. They meet the triple requirement of portability, dependability and accurate control.

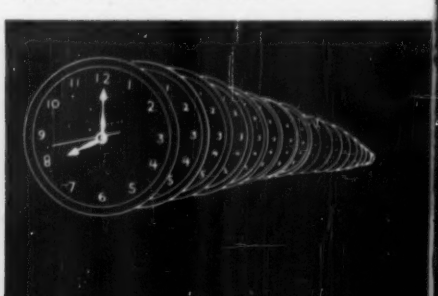
JET ASSIST. Caterpillar Portable Electric Sets supply dependable power for starting jet engines and for calibrating control systems.



ALONE. Without benefit of people to look after them, Cat Electric Sets furnish power for gap filler sites in our aircraft warning system. They are used at larger bases, too.



ENDURANCE. At Air Force Bases in the Atlantic, Cat Electric Sets have run over 20,000 hours without overhaul, while supplying 68,000 kwh a month.



TECHNICIAN checks out portion of Librascope computer which is undergoing shakedown tests at National Aviation Facilities Experimental Center (NAFEC).

computer output goes into the buffer drum at a fast rate and then feeds out at a slower rate compatible with teletype and print-punch unit speeds.

The buffer drum, which rotates at 12,000 rpm., provides 10 data storage bands each with a 120-word capacity. Three of these bands are allocated to handle incoming teletype data while the remaining seven store outgoing data for teletype lines and print-punch units.

Incoming information on aircraft flight plans, including such items as airplane type, speed, altitude, air carrier identification, wind direction and velocity, estimated time of departure, plus computer-calculated estimated time of arrival over designated check points is stored in large magnetic drums which rotate at 1,800 rpm.

Each central computer can accommodate up to 16 such file drums, each drum having a capacity of 16,000 eight-character words for a total maximum capacity of 256,000 words. The storage drums can be programed for either dual or single operation. In the dual-position mode of operation, information is stored in duplicate for back-up.

When data is transferred out of the drum to the fast "scratch-pad" core-type memory, it is transferred in duplicate and given a parity check for agreement, but only one is subsequently transferred to the computer for computation. This allows the original data to be retained in the event the computer "errs" in its subsequent calculations. The file drum has an average access time of 16½ milliseconds. The 4,000 word-magnetic core memory has a 24 microsecond read-write cycle time.

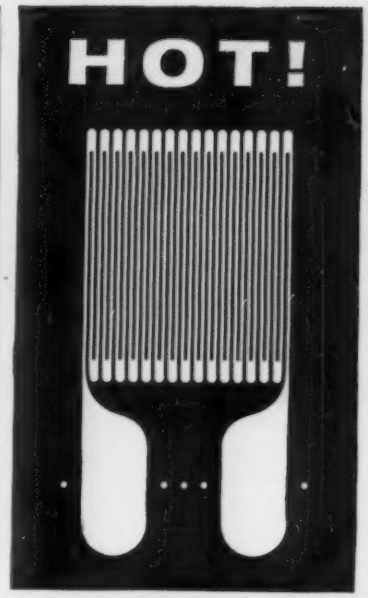
The Librascope computer, or data processor, is a binary coded decimal machine that operates in parallel-serial fashion. Characters are transferred out of memory in parallel fashion, but the arithmetic operation operates serially on the characters.

Word length consists of eight seven-bit characters. Instructions are one word in length with a single address. Computer can perform 31 different operations. Average computing speed for addition and subtraction is 30 microseconds; for multiplication and division, average speed is 266 microseconds. The machine can search through 256,000 words stored in its 16 file drums in one-half second.

The computer can perform internal computations or handle input-output messages while it is simultaneously searching its storage file drums. This is an important feature because the machine will necessarily conduct frequent searches for conflict between aircraft.

General Precision has designed the system so that a central traffic control computer can work with as many as 30 sector consoles at an Air Route Traffic Control Center. Each console contains a magnetic drum, rotating at 1,800 rpm., which serves as a buffer to store information entered periodically by controllers until it is extracted and fed into the computer at an efficient (high) data rate.

A switching mechanism in the central computer automatically interrogates in sequence each of the sector console buffer drums, stopping and extracting any new information that has been entered by the controller at that console.



New Tatnall MetalFilm 102 higher-temperature backed strain gages from Bell

- Operating range to over 400°F surpasses previous strain gages by at least 50°F in all applications.
- Precision-designed and constructed for exceptional accuracy, repeatability and ruggedness.
- Ultra-thin (less than 0.0015 in.), with no integral leads, for high flexibility and conformability.
- High uniformity in both geometry and temperature coefficient for automatic matching.
- Wide range of sizes and configurations available, including standard configuration shown above, rosette and miniature types.

Call or write for full information.

INSTRUMENTS DIVISION

THE Bell COMPANY

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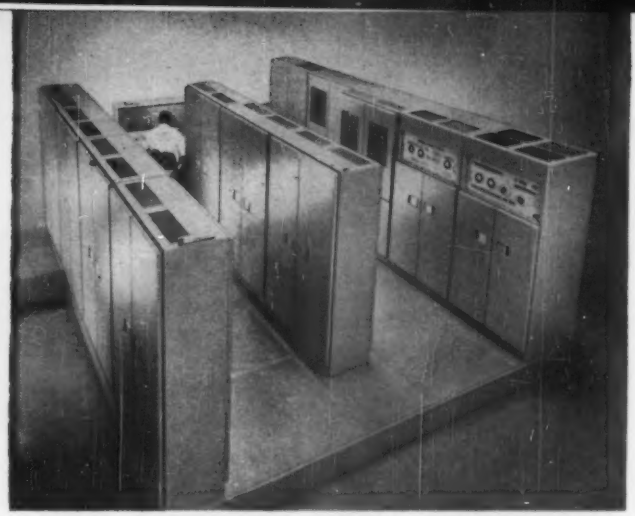
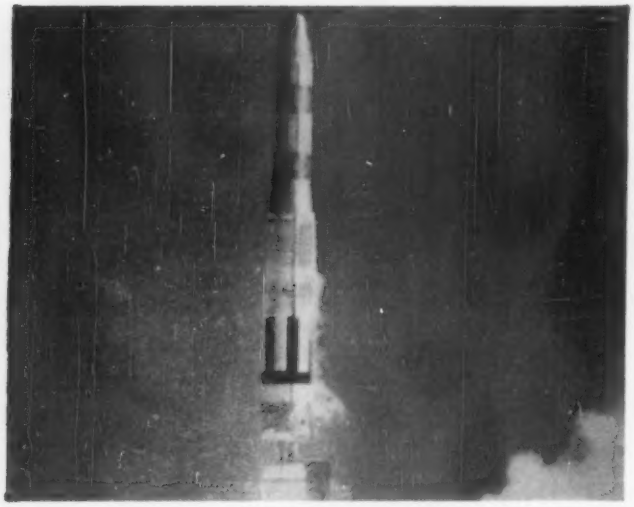
Los Angeles 23, Calif.
Merchant's Exchange Bldg. Room 316
465 California St., San Francisco, Calif.
In Canada:
Tatnall Measuring and Nuclear Systems, Ltd.
46 Hollinger Road, Toronto 16, Ont.
In Europe:
BUFRA
10 Avenue de la Grande Armée
Paris, 17e, France



Building the Athena called for the development of new and rigorous quality control techniques to insure the reliability of its more than 100,000 components and 120,000 selectively soldered joints. All components were classified by Univac data processing equipment, which also kept permanent records of their performance.



Athena is the ground based guidance computer for the USAF Titan ICBM. The Athena continually computes the speed, elevation, direction, azimuth, and position of the Titan and compares this information with data stored in its magnetic memory. Responding to commands issued by the computer, the missile maintains a course which will put it on target.

From the REMINGTON RAND UNIVAC

Military Division

Ultra-Reliable Athena Computer Guides ICBM Titan to Target 5,000 Miles Away

Recently an ICBM Titan missile was fired from Cape Canaveral by the USAF Ballistic Missile Division. The accuracy of the ground-based guidance system was such that technicians were able to quickly recover a data capsule within a target area 5,000 miles away.

This same system made possible the highly successful launching of TIROS I, America's television-equipped weather-eye satellite. The Athena computer, guiding a three-stage Thor-Able type missile, put TIROS I into the most nearly perfect circular orbit of any satellite, Russian or American, yet launched.

The Athena Digital Guidance computer was designed and produced by Remington Rand Univac to meet unprecedented reliability requirements. Several Athena computers have since been delivered and have logged thousands of operating hours. All have exceeded a reliability rating of 999.92 per cent, a record considered as a major breakthrough in the computer art.

The Athena is now a proud addition to the distinguished series of defense systems developed by the Military Division. In exceeding the contract specifications for reliability and delivering the computer ahead of schedule, the Athena program once more demonstrated the outstanding military capabilities of Remington Rand Univac.

UNIVAC®

Remington Rand

UNIVAC

DIVISION OF SPERRY RAND CORPORATION

Univac Park, St. Paul 16, Minnesota

Control and data systems developed by the Remington Rand Univac Military Division include:

ATHENA, the Ground Guidance Computer for the U.S. Air Force ICBM TITAN.

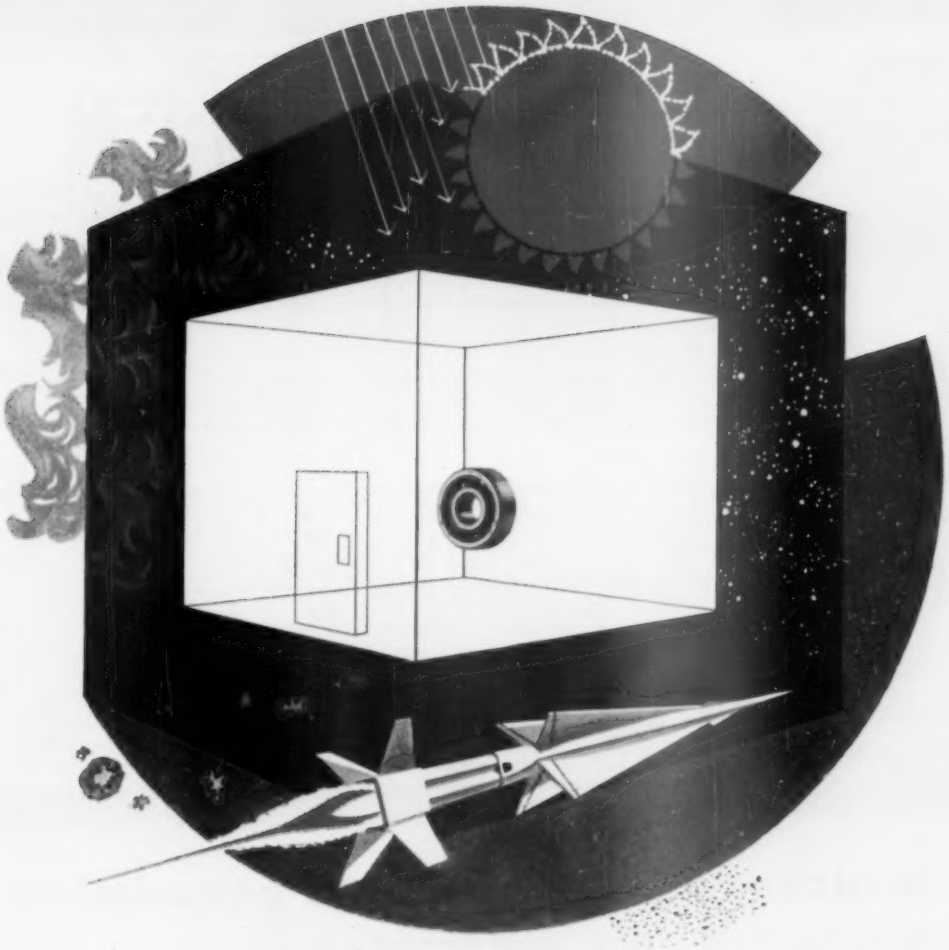
TACS AN/TSQ-13 (Tactical Air Control System for the U. S. Air Force)

BOMARC Computer for the U. S. Air Force Target Intercept Program

SEA SURVEILLANCE SYSTEM FOR THE U. S. NAVY

AN/USQ-20 (Advanced Computer for the U. S. Navy)

Additional information describing capabilities and experience or career opportunities may be obtained by writing to Remington Rand Univac at the above address.



- THOR
- MACE
- TITAN
- HAWK
- ATLAS
- SNARK
- NIKE B
- BOMARC
- NIKE ZEUS
- SPARROW I
- SPARROW II
- SPARROW III
- NIKE HERCULES
- SIDEWINDER
- REGULUS II
- VANGUARD
- REDSTONE
- JUPITER C
- PERSHING
- BULL PUP
- MERCURY
- TERRIER
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- TARTAR
- CORVUS
- FALCON

N/D's Unique "White Rooms" Improve Miniature Ball Bearing Reliability!

In these rooms infinitesimal air-borne contaminants are scientifically whisked from the air . . . away from super-precision miniature ball bearing parts. New Departure's White Rooms date back nearly twenty years. And today, they're a major factor in N/D's growing recognition as a leader in M/I ball bearing reliability.

At N/D, miniature ball bearings are completely assembled in properly humidified, temperature controlled atmospheres. Advanced air filter systems completely change the air in these spotless rooms every few minutes. In addition, pressurized access air locks and individual counter-top pressurized chambers are used by N/D's skilled technicians during final assembly and statistical inspections.

These methods and equipment are only a few of the reasons why more and more major missile contractors, today, rely on New Departure Miniature and Instrument ball bearings.

If you are working on a new miniature ball bearing application where reliability is critical, include an N/D Sales Engineer in your design discussions. Call or write Department L.S., New Departure Division, General Motors Corporation, Bristol, Connecticut.

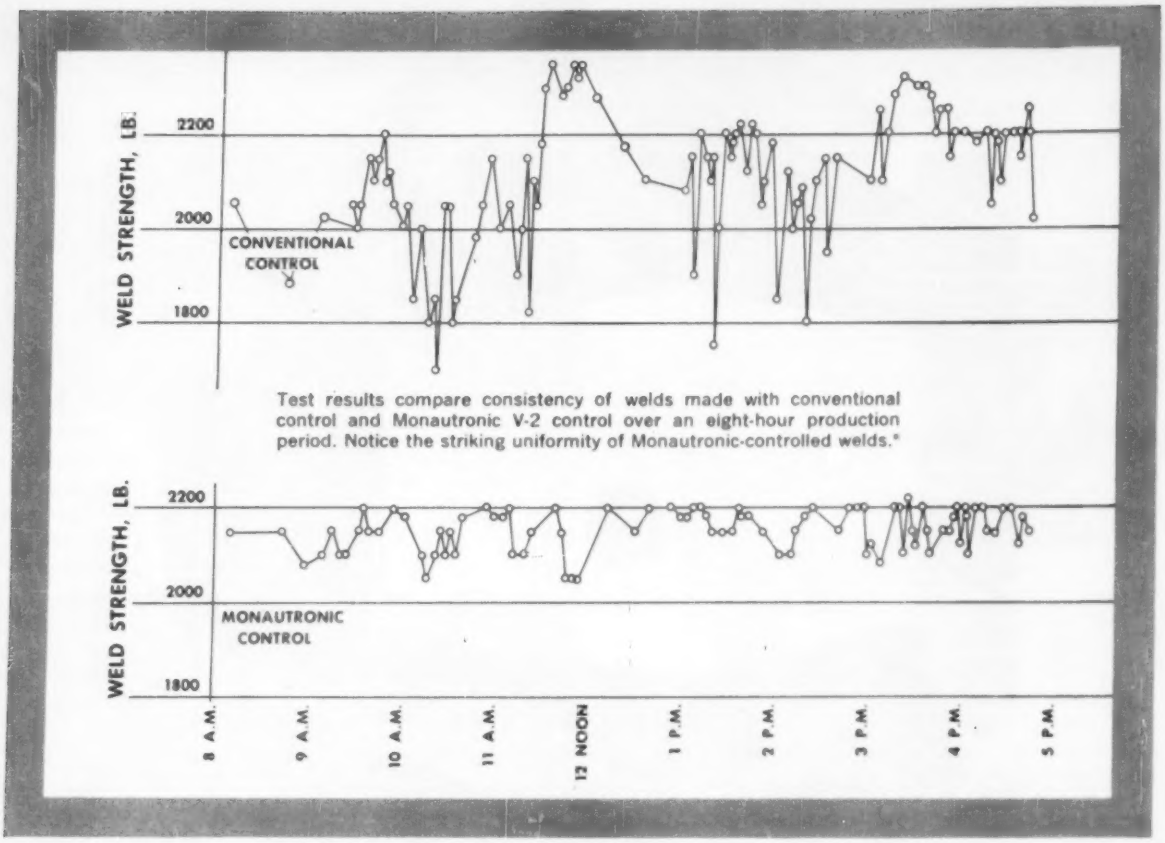
NEW DEPARTURE

MINIATURE & INSTRUMENT BALL BEARINGS

proved reliability you can build around

TACS AN/TSQ-13 (Tactical Air Control System for the U. S. Air Force)

Additional information describing capabilities and experience or career opportunities may be obtained by writing to Remington Rand Univac at the above address.



Test results compare consistency of welds made with conventional control and Monautronic V-2 control over an eight-hour production period. Notice the striking uniformity of Monautronic-controlled welds.*

new feedback control gives you consistently high quality welds . . . automatically

Monautronic V-2 welding control has fully automatic sequencing with all provisions for single spot, roll spot and seam welding.

The new *Monautronic V-2* welding control makes use of the latest advances in electronic computing to overcome automatically such obstacles to weld quality as line voltage fluctuation, electrode wear, variations in electrode tip force, surface finish and shunting.

The control compensates for undesirable variations usually encountered in resistance welding by maintaining voltage across a weld at a constant value. This constraint of voltage amounts to constraint of final weld temperatures, and such temperature control assures uniform production of high quality welds.

Any metal that can be resistance welded can be welded better with the Monautronic V-2 than with any other control on the market.

For complete details, contact THE BUDD COMPANY, Electronic Controls Section, Philadelphia 32, Pa., or one of our regional offices.

*Case study upon request.

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ELECTRONIC Budd CONTROLS

FILTER CENTER

▶ **Optical Communications**—Single transistorized unit which contains an arc lamp as a visible light source and a modulator and detector has been developed by Electron Arc Division, Ionics, Inc., 244 Broad St., Lynn, Mass. Unit which has previously employed infrared and ultraviolet sources, could be used in highly directional optical communication system (AW Dec. 14, p. 87 and Feb. 22 p. 63).

▶ **Preferred Circuits Handbook Supplement**—A second supplement to the Handbook of Preferred Circuits originally prepared by National Bureau of Standards under Navy sponsorship, is now available for 30 cents from Office of Technical Services, Commerce Dept., Washington 25, D. C. Supplement is identified as NAVAER 16-1-519, Supplement No. 2.

▶ **Transistor Sales Still Climbing**—U. S. semiconductor manufacturers sold 9.6 million transistors in January, an 86% increase over same month last year and a 23% increase over December's sales. In terms of dollars, January 1960 sales were 86% above previous year and 9% above December.

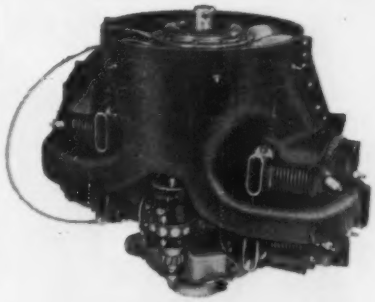
▶ **Fairchild Camera & Instrument Corp.**—will develop an integrated mapping system for the Army Engineer Research and Development Laboratories under a $283,115 contract. The system is to provide contour information, orthophotographs and a tape record from the output of a standard stereo plotter.

▶ **Entering Semiconductor Business**—Kearfott Division of General Precision, Inc., is setting up a semiconductor production department headed by Massachusetts Institute of Technology personnel. The new department to be located in Boston, will make specialized devices as well as more general devices for which a market appears to exist outside the firm.

▶ **Signed on the Dotted Line**—Contract award recently announced by avionics manufacturer:

• **Hermes Electronics Co.** will design and manufacture spectrographic infrared preselectors to be used in the Navy's Artificial Earth Satellite Observation Program (AESOP). The devices, to be made under a $700,000 contract from the Office of Naval Research, are designed to detect silent satellites automatically and provide velocity tracking information.

NOW—FAA CERTIFICATED



NELSON Model H-63C
HELICOPTER
ENGINE

- 43 hp shaft output to gearbox @ 4,000 rpm
- 76 lbs. total weight, complete with generator, starter, cooling fan and shrouds, carburetor, dual ignition system, centrifugal clutch, motor mounts.
- Four cylinder, two cycle, air cooled.
- Operates in any position.

Write for particulars

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When this country's first astronaut is launched into space a Bohanan Antenna Fairing Ejector and Bohanan ballistically operated valves will function as precise members of the recovery system "team."

Each of these products incorporates the design skill and thorough testing diligence that have made Bohanan products symbols of reliability... assurance that results from *planned* programming. Each Bohanan design engineer is supported and complemented by a complete program of reliability control. The program consists of design review, equipment and parts testing, fabrication and assembly vigilance and 100 per cent screening tests. Each of the Bohanan products provided under contract to McDonnell Aircraft for the National Aeronautics and Space Administration's Project Mercury Capsule has been subjected to these controls countless times.

Bohanan's engineering, production and test facilities are available to help with your space age problems.

Write today for your free copy of the "BOOK ON BOHANAN".

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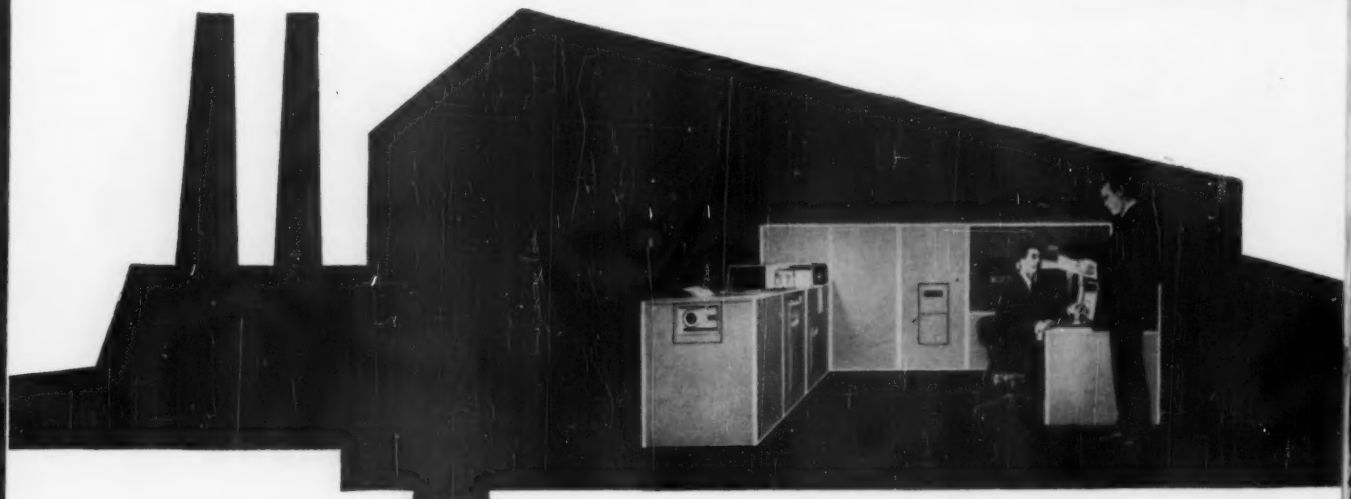
one late decision on inventory and this $50 part could cost you $5,000



IBM RAMAC® 305

controls inventory data to prevent costly "out-of-stock" conditions

A delay in production caused by an "out-of-stock" part can make that part the most expensive item in your stock. IBM RAMAC 305 gives you the fast and accurate control over inventory that helps you avoid costly shortages—or equally costly overstocking.

As each transaction is entered into RAMAC, all affected records are immediately posted and updated. Management may inquire as to the status of any specified item in inventory. This random access ability is an exclusive feature of the IBM RAMAC.

Balanced Data Processing . . . IBM services as well as machines . . . is a continuing responsibility of IBM to its customers. Like all IBM data processing equipment, RAMAC 305 may be purchased or leased.

IBM®

balanced data processing

NEW AVIONIC PRODUCTS

Components & Devices

• **Drift Angle Indicator,** T8608-21, provides ground speed information on a 3-drum counter and drift angle on a calibrated dial and is integrally illuminated according to MIL-L-25467A. Indicator is constructed according to Arinc characteristic No. 540 and is designed

for commercial transport aircraft. Unit requires 115 v., 400 cps., weighs 4 lb., and displays drift angle to within ½ deg. and groundspeed to within 3 kt. Kearfott Division of General Precision, Inc., 1150 McBride Ave., Little Falls, N. J.

• **Low-level amplifiers,** Model 10-108-2 and 12-105-0, are designed to operate from 115 v. 400 cps. and 28 v.d.c. sources respectively, and are suited for temperature and strain measurements in industrial and military applications. Designed to accept input signals in the millivolt range, these units produce an

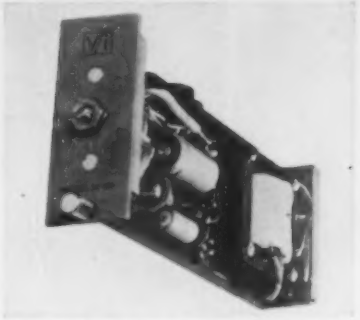
output signal ranging from zero to 5 v.d.c., weigh 12 oz., and have gain stability of ±1% for 10% supply voltage change and ±3% between 0 and 65C. Magnetic Research Corp., 3160 W. El Segundo Blvd., Hawthorne, Calif.

• **Mesa transistors,** Types 2N705 and 2N710, are high-speed switching pnp diffused-base germanium units hermetically sealed in TO-18 packages. In one typical operation, the 2N705 has 75 nanosecond turn on time, 100 nanosecond storage time and 100 nanosecond fall time. These units are designed to withstand the mechanical and environmental requirements of MIL-S-19500B, according to the manufacturer, Sylvania Electric Products, Inc., Semiconductor Division, 100 Sylvan Rd., Woburn, Mass.

• **Switching Transistors,** 327 series, are pnp silicon alloy units for switching and general purpose applications at low and medium power levels for use in audio, servo and d.c. amplifiers. Series has been engineered to exceed MIL T-19500 requirements for resistance to acceleration, shock, strong impact, and thermal fatigue. Western Transistor Corp., Gardena, Calif.

• **Magnetic amplifiers,** Series 5800, can deliver up to ±5 v. into a 50 kilohm load at accuracies of 0.1% in a single stage of amplification. Series features built-in temperature compensation, a filtered output and inherent high gain and reliability, according to the manufacturers, Airpax Electronics, Inc., Fort Lauderdale, Florida.

Power Supplies



• **Strain Gage Supply,** Model SR 150, has 0.1% regulation, floating output at an internal impedance of less than 0.2 ohm, noise to ground of less than 10 microvolts peak-to-peak when measured with a 350-ohm bridge and leakage resistance in excess of 10,000 ohms, according to the manufacturer. Power supply is priced at $68 f.o.b. company, Video Instruments Co., Inc., 3002 Pennsylvania Ave., Santa Monica, Calif.

• **Power Supply,** type SCRT 32-15-1, has been designed to supply regulated 10 to 32 v.d.c. at 0 to 15 amp. with both sides floating with respect to the ground. Dynamic response is less than 100 millivolts transient spike for 100 microseconds, for ±2% amp. step

change in load current and less than 1 v. transient spike for 0.1 millisecond for step load change from 15 amp. to zero amp. Ripple is less than 1 millivolt rms. Del Electronics Corp., 521 Homestead Ave., Mt. Vernon.

NOW OPERATIONAL: Weather-sounding rockets carrying R/M Pyrotex® motor-tube liners

Motor-tube liners for new weather-sounding rockets are R/M Pyrotex asbestos-phenolic tubes. These liners withstand a direct rocket blast for periods up to 90 seconds.

High ablation-resistance, good thermal insulation, high strength-to-weight ratio—all resulting from the unique R/M blend of phenolic resins and extra-long spinning-grade asbestos fibers – make choice of R/M Pyrotex materials clear for this and many other high-temperature applications.

Test R/M materials without tooling costs. We can supply your testing program with molded billets or tubes from which you can machine your prototype parts at the cost of the materials alone – *no charge for tooling.* What better way to learn the merits of an exciting new material for nozzles, exit cones, fins, nose cones, etc.? Phone, wire or write your requirements.

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Reinforced Plastics Department, Manheim, Pa.

SPECIALISTS IN ASBESTOS, RUBBER, ENGINEERED PLASTICS, SINTERED METAL

HELPING HANDS IN THE RACE FOR SPACE

Helping Hands of Stratos engineers are assisting space age industries in developing reliable missile and space equipment. Supported by excellent facilities on both coasts, Stratos' creative engineering team is making major advances in such areas as cryogenics, propellant and nuclear hot gas APU's, hot gas servos, air conditioning and electronic cooling, high-pressure pneumatic systems and fuel and oxidizer valves. Stratos achievements in these fields are providing a vital assist in the race for space.

STRATOS

A DIVISION OF FAIRCHILD ENGINE & AIRPLANE CORPORATION

Main Plant: Bay Shore, Long Island, New York

Western Branch: 1800 Rosecrans Avenue, Manhattan Beach, Calif.

Aerospace Industry—1959 Financial Results

	SALES (in millions)			EARNINGS (in millions)			PROFITS PER SHARE			BACK LOG (in millions)			PROFIT MARGIN SALES			PROFIT MARGIN NET WORTH		
	1959	1958	1957	1959	1958	1957	1959	1958	1957	1959	1958	1957	1959	1958	1957	1959	1958	1957
Aerojet-General	364	218	161	8 203	6 027	3 818	1 82	1 38	78	.....	.....	.....	2.2%	2.7%	2 3%	%	18 6%	14 3%
Arma	119	115	134	3 532	4 100	5 080	1 83	2 14	2 67	128	219	.....	2 9	4 1	3 7	.....	16	18
Avco	309[6]	282	314	9 588	11 596	12 832	95	1 24	1 38	.....	.....	.....	3 1	4	4 1	9	11 6	14 2
Beech [7]	89	95	103	3 968	3 324	3 369	4 74	4 03	4 09	.....	.....	.....	4 4	3 4	3 2	15 4	14 4	19 2
Bell	128	182	202	3 388	4 758	4 346	.....	1 77	1 62	.....	.....	.....	2 6	2 6	2 1	.....	10 6	10 2
Boeing	1,612	1,711	1,596	12 435	29 360	38 159	1 65	3 93	5 17	2 000	2 445	2 452	0 77	1 72	2 39	5 9	14 5	21 5
Burroughs	359	294	282	10 745	6 407	10 074	1 62	1 02	1 67	.....	.....	.....	1 9	2 1	3 5	5 8	5 2	9 4
Cessna [7]	105	095	079	7 937	5 109	4 695	7 41	4 84	4 45	33	45	.....	7 5	5 3	5 9	24	19 4	20 5
Chance Vought	254	333	237	4 899	8 957	6 152	4 12	7 55	5 65	253	370	670	1 9	2 7	2 6	11 4	20 4	18 5
Collins Radio	117	107	127	3 718	1 081	2 192	1 95	54	1 25	.....	.....	.....	3 16	1 01	1 72	12 6	4 2	12 4
Curtiss-Wright	329	398	598	14 302	25 053	40 075	.....	3 11	5 07	Not reported	260	293	4 2	6 4	6 7	7	12	20
Douglas	883	1,209	1,091	(33 822)	16 847	30 665	(8 86)	4 41	8 03	1,317	1,543	1,805	(3 83)	1 39	2 81	(2 5)	9 5	18
Fairchild	113	148	158	1 515	(17 435)	503	50	(5 74)	17	76	135	.....	1 3	Loss	31	7	Loss	1 3
Garrett	193	170	176	4 767	4 118	4 940	4 61	.....	.....	114	120	140	2 4	2 4	2 8	13	12	16
General Dynamics	1,811	1,626	1,666	31 056	48 395	55 689	3 12	3 71[1]	4 80[1]	2,555	2,095	1,750	1 7	2 95	3 3	9 4	15 2	19 6
General Precision	215	168	185	4 198	304	4 263	2 63	.....	3 03	.....	.....	.....	1 9	18	2 3	6 6	51	6 9
General Electric	4,349[2]	4,120	4,090	280	242	247	3 19	2 78	2 84	.....	.....	.....	6 4	5 9	5 7	19 2	18 5	20
Grumman	288	225	205	4 938	2 492	5 235	2 24	1 13	2 38	260	175	.....	2 55	1 11	1 70	11 7	5 1	9 9
Hiller	16	13	11	305	327	228	56	80	61	12	18	13	1 9	2 5	2 1	5 8	9 7	8 5
Kaman	34	21	15	589	513	465	1 50	1 38	1 39	.....	.....	.....	1 7	2 4	3	15	15 6	17 4
Lear	87	63	64	2 407	1 607	858	91	68	36	76	71	64	4 2	2 5	1 3	13 6	11 8	7 2
Litton Industries	125	83	28	5 975	3 702	1 806	3 24	2 13	1 51	.....	.....	.....	4 7	4 4	6 3	17 2	13 2	23
Lockheed	1,301	973	878	8 733	18 845	16 590	1 24	2 92	2 61	1,155	1,166	1,288	7	1 9	1 9	6	13 8	14 2
Marquardt	69	49	41	1 311	1 131	1 035	98	87	81	57	89	46	1 9	2 2	2 4	14	15	17
Martin	523	483	423	13 337	11 726	9 880	4 34	3 82	3 22	900	831	.....	2 5	2 4	2 3	16 8	16 6	15 5
McDonnell [4]	435	442	335	10 037	10 028	9 671	6 10	6 09	5 88	541	505	728	2 30	2 27	2 88	22 2	27 4	34 8
North American [7]	1,044	904	1,243	30 726	26 786	33 864	3 80	3 34	4 22	662	513	581	2 95	2 95	2 7	15	14 5	19 4
Northrop [4]	263	274	281	7 325	7 234	5 522	4 01	4 31	3 62	204	254	216	2 78	2 6	1 9	16	19	17
Piper	34	27	26	2 782	2 188	2 722	1 00	1 00	1 00	.....	.....	.....	8 1	8	10 2	26	24 6	35
Raytheon	494	375	259	10 481	9 403	4 828	3 01	3 08	1 70	300	280	260	2 1	2 5	1 9	14 9	17 2	10 5
Republic	197	218	269	3 386	5 121	6 103	3 25	3 48	4 15	511	408	352	2 3	2 3	2 1	9 8	12 3	15 7
Rohr Aircraft [4]	191	147	115	2 586	4 022	3 727	1 40	4 28	4 14	221	245	237	1 3	2 7	3 2	.....	22	25
Ryan	84	73	76	2 812	2 287	1 804	1 72	1 70	1 34	145	129	117	3 3	3 1	2 3	1 8	15 6	14 3
Sperry [7]	989	864	868	27 644	27 481	49 612	96	96	1 74	835	637	.....	2 8	3 2	5 7	8	8	14 6
Texas Instruments	193	091	67	14 143	6 001	3 765	3 59	1 84	1 11	.....	.....	.....	7 2	6 5	5 6	25	23 4	19 2
Temco	100	119	119	1 163	2 555	2 514	68	1 50	1 48	83	108	160	1 1	2 1	2 1	8 1	18	20
Thiokol	190	88	55	5 521	3 007	1 816	1 22	72	47	.....	.....	.....	2 9	3 35	3 2	22	16	18
Thompson Ramo Wool.	417	340	412	9 743	8 979	12 137	3 02	2 86	3 90	.....	.....	.....	2 3	2 5	2 9	8 4	8 2	11 4
United Aircraft	1,080	1,200	1,232	28 638	42 294	51 366	4 25	6 40	7 96	1,010	1,400	1,975	2 6	3 5	4 2	9 9	15 2	20
Western Electric	2,322[5]	2,163	.....	102 188	85 936	.....	5 92	5 17	.....	.....	.....	.....	4 4	3 9	.....	.....	.....	.....
Westinghouse Electric	1,910	1,895	2,009	85 947	74 773	72 653	4 86	4 25	4 18	.....	.....	.....	4 5	3 95	3 6	9 3	8 5	9

[1] Prior to Merger—Material Service Corp.
[2] Defense Sales approximately 25% of this total.
[3] Fiscal Year ended March 31, 1959.
[4] Fiscal Year ended July 31, 1959.
[5] Defense Sales totaled $682,075 in 1959, $575,961 in 1958.
[6] 57 per cent for defense business.
[7] Fiscal year ended Sept. 30, 1959.
[8] Fiscal year ended June 30, 1959.

New Offerings

General Atronics Corp., Bala-Cynwyd, Pa., a research and development organization concerned with the generation, exploration and introduction of new ideas and advanced techniques in electronics, in the physical, mathematical and managerial sciences. Offering is 155,660 shares of common stock for public sale at $3.50 per share. Proceeds will be used for additional laboratory and production equipment; for additional developmental engineering and sales promotion of materials handling equipment; for investment in Atronic Learning Systems, Inc.; for repayment of bank loans; for working capital. The company is forming Atronic Learning Systems, Inc., to carry forward a learning system involving the use of a mechanical learning device for use in industrial and governmental organizations.

United Industrial Corp., Los Angeles, Calif., engaged in developing, engineering, manufacturing and selling a variety of electro-mechanical products, communications equipment, automation controls, and electronic systems and products for use in aircraft, missile and general industrial fields. Offering is 88,017 shares of Series A convertible preferred stock, 614,130 shares of common stock, and 16,500 common stock purchase warrants.

In September, 1959, the company was organized as Topp Industries Corp. (in Delaware), and in October, 1959, acquired the business and assets and assumed the liabilities of Topp Industries, Inc. In December, 1959, the merger of United Industrial Corp. (a Michigan corporation) into the company became effective and the name of the company was changed from Topp Industries Corp. to United Industrial Corp. Prior to the merger, stock purchase warrants were distributed on the basis of one warrant for each share of the company's common stock to stockholders of record Oct. 28, 1959; each warrant now evidences the right to purchase ½ share of common at $17 per share, and 509,613 shares are reserved for issuance upon exercise of these warrants. Additional common shares are issuable upon conversion of debentures and preferred stock and under a stock option plan.

Scott Aviation Corp., Lancaster, N. Y., manufacturer of protective breathing apparatus used in both civil and military aviation. Offering is 169,680 shares of common stock; 62,000 shares to be offered for public sale by the company and 107,680 outstanding shares by the holders thereof. Offering price and underwriting terms to be supplied by amendment; 8,000 shares are to be reserved for allotment to directors, officers and employes of the company. Proceeds of the 62,000 shares will be used to pay off $300,000 of bank indebtedness and for general working capital purposes.

Telectro Industries Corp., Long Island City, N. Y., engaged in the development and manufacture and sale of magnetic tape recorders for instrumentation and audio applications, as well as other electronic equipment for government and commercial application. Offering is $1,000,000 of 6½%

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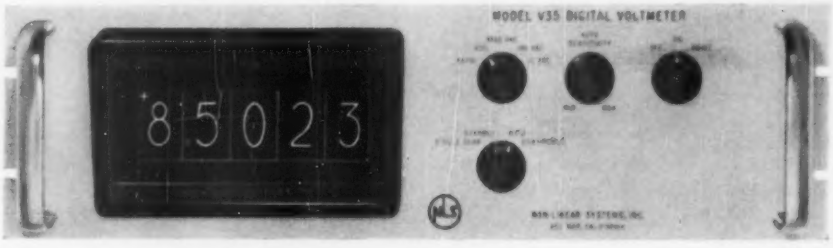

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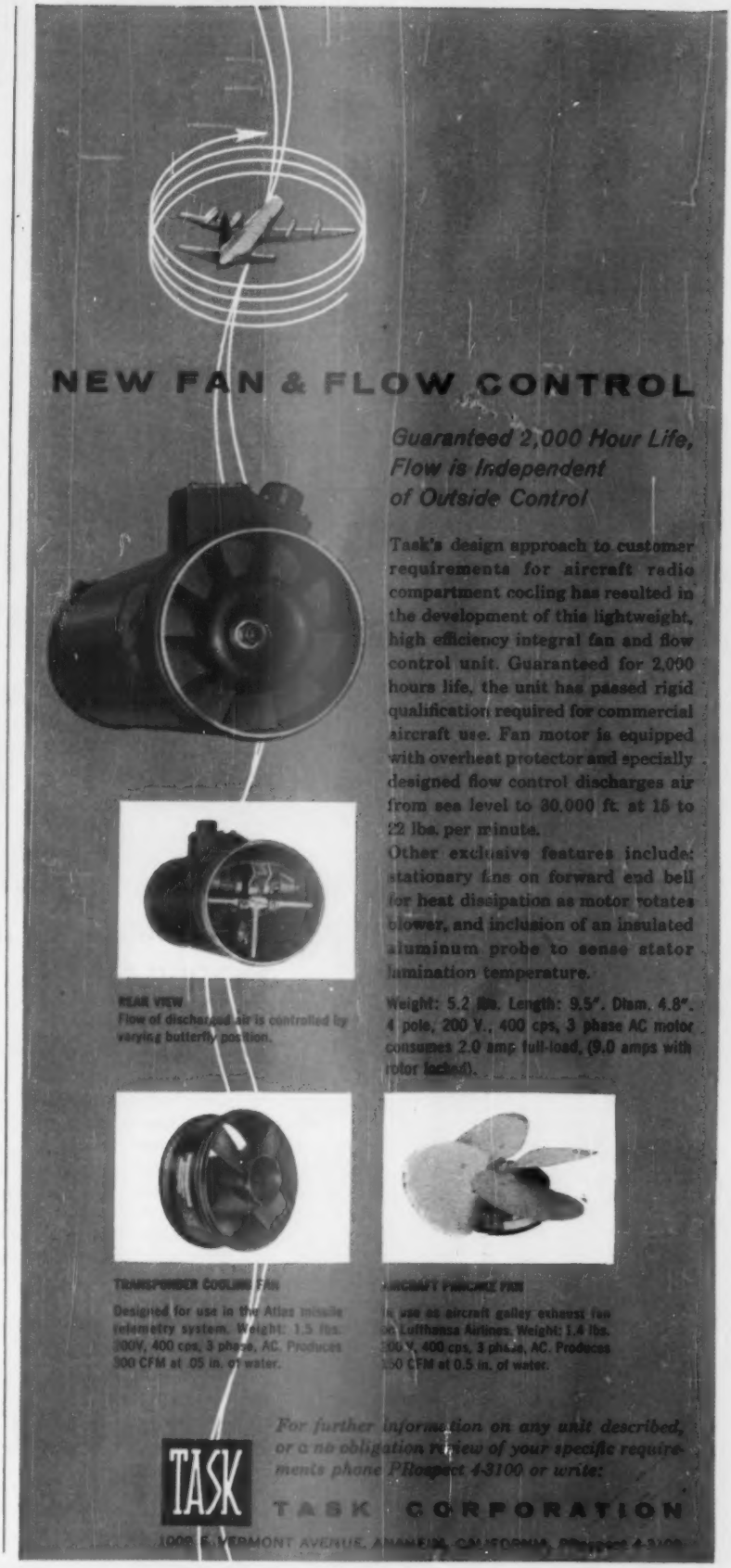
convertible subordinated debentures, due 1970, for public sale at 100% of principal amount. Registration also includes 25,000 common shares issuable under the company's restricted stock option plan for key employes, and 30,000 shares held by two officers (but not being offered at this time). Proceeds will be used to eliminate an outstanding bank loan of $700,000, and to provide additional working capital to be used in part to reduce outstanding accounts payable.

Hydra-Power Corp., New Rochelle, N. Y., engaged primarily in the manufacture of hydraulic, pneumatic and fuel valves, brake controls, as well as servo control actuators and other related products for guided missiles, rocket engines, and aircraft, including helicopters. Offering is $600,000 of 6½% subordinated debentures, due 1970 (with warrants to purchase 150,000 common shares for each $1,000 debenture), for public sale at 100% of the principal amount of the debentures. Registration also includes 30,000 common shares owned by four officers of the company (but not now being offered), and 14,500 shares reserved for possible conversion of options. Proceeds will be used for capital equipment, raw material and to finance work-in-process and finished products for Powertronics Systems, Inc., a subsidiary engaged in research and development of a new line of products such as voltage regulators and regulated power supplies; for similar purposes with respect to the operations of Electro Powerpacs, Inc., a subsidiary engaged in the design and production of photographic and emergency lighting equipment; for reduction of a portion of a $200,000 bank loan; the balance for general corporate purposes.

Superior Electric Co., Bristol, Conn., engaged in designing, developing, manufacturing and selling various lines of electronic and electric controls. Offering is 150,000 shares of common stock for public sale; offering price and underwriting terms to be supplied by amendment. Proceeds will be used to finance in part the construction of a new plant to consolidate all of the company's manufacturing activities.

Pendleton Tool Industries, Inc., Los Angeles, Calif., manufacturer of hand service tools, tool boxes, special ground support equipment for aircraft industry, and precision parts for aircraft, electronic and guided missile industries. Offering is 50,000 shares of common stock for public sale; offering price and underwriting terms to be supplied amendment. Of the proceeds, $500,000 will be used to retire a 5% note given to The V-T Co. in partial payment of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its business and certain of its assets; the remainder will be added to working capital.

Ets-Hokin & Galvan, Inc., San Francisco, Calif., engaged in commercial and industrial electrical and electronic contracting; recent operations include the installation of electrical and electronic systems in missile production facilities and in missile and satellite base installations, including ground support systems for testing and operational sites, as well as tracking systems for missiles and satellites. Offering is 250,000 shares of common stock, for public sale at $5.30 per share. Proceeds will be added to working capital and used principally to reduce accounts payable and notes payable.

Acquisitions And Mergers

Magnetic Amplifiers, Inc., of New York City, has merged into the Siegler Corp., of Los Angeles, producer of equipment utilizing solid state devices. Deal involved exchange of one share of Siegler common stock for three and one-half shares of Magnetic Amplifiers common. Magnetic Amplifiers, which makes flight control systems for aircraft and missiles, airborne and ground power supplies, Tacan equipment and missile checkouts, will become a Siegler division.

Sperry Rand Corp. has purchased the assets of the Clary Corp.'s Adding Machine and Cash Register Division for a cash amount of about $8,050,000, subject to approval by Clary stockholders and the Sperry Rand board. Clary will continue to design and build electronic computers and guidance and propulsion systems for missiles.

Waltham Precision Instrument Co. has acquired Electro-Mec Laboratory, Inc., Long Island City, which designs and manufactures high precision potentiometers.

CompuDyne Corp., Hatboro, Pa., manufacture of computer-operated electrohydraulic control systems for aircraft and missiles, has acquired American Measurement & Control, Inc., of Waltham, Mass., which also makes servo equipment. Terms were an exchange of 80,000 shares of CompuDyne stock for all shares of American Measurement's stock. Donald G. O'Brien, American Measurements founder, will continue as general manager and has joined the CompuDyne board.

The Wyle Corporations have acquired Burgoyne Testing Laboratories, Westbury, N. Y., renaming the firm Wyle-Burgoyne, Inc. Action was taken by Frank S. Wyle to broaden his firm's nationwide facilities for aircraft and missile testing services.

Clevite Corp., of Cleveland, Ohio, has acquired the assets of the Shockley Transistor Corp., Palo Alto, Calif., a subsidiary of Beckman Instruments, Inc. Shockley unit will become part of Clevite's Transistor Product Division, which headquarters at Waltham, Mass. Clevite says it plans to provide new production facilities in Palo Alto for its new acquisition.

Financial Briefs

Television-Electronics Fund, Inc., eliminated from its portfolio in the first quarter ended Jan. 31 its common stock holdings in General Precision Equipment Corp. The Chicago mutual fund added common stocks of Allis-Chalmers Manufacturing Co., Carborundum Co., Curtiss-Wright Corp., Ford Motor Co., General Electric Co., General Motors Corp., Hoffman Electronics Corp. and United Utilities, Inc. Reductions were made in the common stocks of Consolidated Edison Co. of New York, Inc., General Telephone & Electronics Corp., Southern California Edison Co. and Walt Disney Productions.

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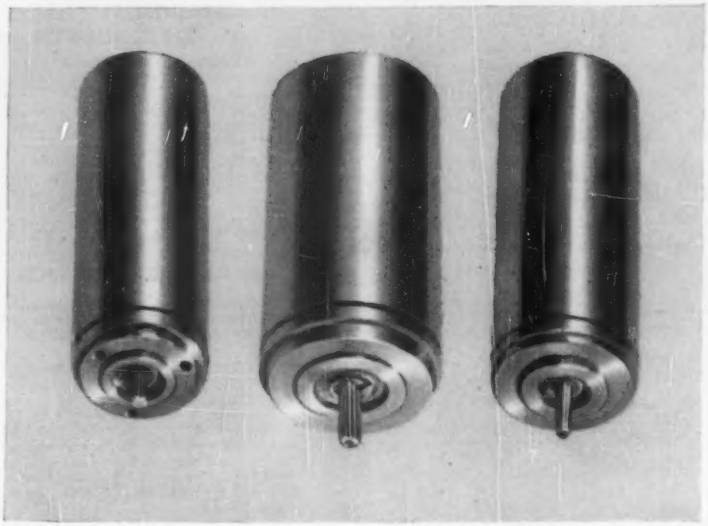

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Stock Transactions

Disposition of Lear, Inc. common shares has been reported by the Securities and Exchange Commission, during the period Jan. 11 to Feb. 10, 1960, as follows: Philip E. Golde, officer and director, 4,000 shares, leaving a holding of 4,104; Andrew F. Haiduck, officer, 5,000 shares, his total holding; Albert C. Keske, officer, 241 shares, leaving a holding of 1,100; William P. Lear, director and beneficial owner, 30,000 shares, leaving a holding of 392,768.

Other transactions for the periods Dec. 11, 1959-Jan. 10, 1960, and Jan. 11-Feb. 10, include:

American Airlines, Inc. Disposition of 1,000 common shares by Samuel C. Dunlap, III, officer, his total holding.

Ampex Corp. Acquisition of 1,000 common shares through exercise of option by Philip L. Gundy, officer, making a holding of 1,550; disposition of 4,000 common shares by Murray Innes, Jr., director, leaving a direct holding of 1,000 and an indirect holding of 667; acquisition of 250 common shares through exercise of option by Neal K. McNaughten, officer, making a holding of 266; disposition of 1,000 common shares by Nathan W. Pearson, director, leaving a holding of 750; disposition of 1,000 common shares by A. M. Poniatoff, officer and director, leaving a holding of 2,850.

Amphenol-Borg Electronics Corp. Disposition of 500 capital shares by Harold R. Egenes, officer, leaving a holding of 1,633; acquisition of 3,250 common shares through exercise of option by Arthur J. Schmitt, director, making a holding of 33,108.

Avco Corp. Acquisition of 364 common shares by C. Coburn Darling, director, making a holding of 7,000; acquisition of 5,000 common shares through exercise of option by James R. Kerr, officer, making a holding of 9,366; acquisition of 1,900 common shares through exercise of option by Frank S. Larson, officer, making a holding of 4,702; disposition of 2,400 common shares by W. A. Mogensen, director, leaving a holding of 9,300; acquisition of 500 common shares by Benjamin H. Namm, director, making a holding of 2,806; acquisition of 7,900 common shares by Kendrick R. Wilson, Jr., officer, making a holding of 16,000.

Beech Aircraft Corp. Acquisition of 400 common shares through exercise of option by John A. Elliott, officer, making a holding of 1,586; acquisition of 105 common shares through exercise of option by Lucille W. Edwards, officer, and disposition of 100 common shares, leaving a holding of 309; acquisition of 1,050 common shares through exercise of option by Leddy Greever, officer, making a holding of 1,991; acquisition of 75 common shares by Frank E. Hedrick, officer, and disposition of 100 common shares, leaving a holding of 9,425; acquisition of 500 common shares through exercise of option by James N. Lew, officer, making a holding of 1,235; acquisition of 450 common shares through exercise of option by Michael G. Neuburger, officer, making a holding of 1,237.

Bell Aircraft Corp. Disposition of 700 common shares by Walter A. Yates, director, leaving a holding of 3,382.

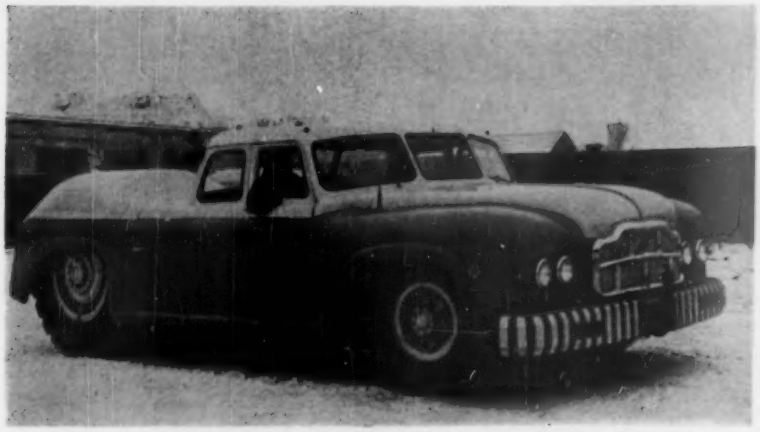
Bendix Aviation Corp. Disposition of 500 common shares by Palmer Nicholls, officer, leaving a holding of 651; disposition of 1,800 common shares by Louis F. Polk, officer and director, leaving a direct holding of 10,100 (indirect holding remains 12,265).

Boeing Airplane Co. Disposition of 700 common shares by J. E. Prince, officer, leaving a holding of 1,692.

California Eastern Aviation. Acquisition of 3,100 common shares by Martin T. Dyke, officer, making a holding of 11,146.

Capital Airlines, Inc. Disposition of 2,000 common shares by Joseph F. Cullmann, III, director, his total holding.

Cessna Aircraft Co. Disposition of 3,000 common shares by Frank A. Boettger,



Soviets Build Starting Tug

Maz-541 tractor, designed for towing and starting Tu-114 and Il-18 turboprop transports, is undergoing evaluation at Moscow's Vnukovo Airport. The 300-hp. tractor, built at a Minsk automobile plant, is said to be the first Soviet tow vehicle equipped to provide electrical starting power. Soviet sources say that models will incorporate necessary improvements made apparent during prototype trials. Note Detroit-influenced headlight treatment.

officer and director, leaving a holding of 5,875; acquisition of 200 common shares by Raymond G. Largent, officer, making a holding of 2,039; disposition of 2,100 common shares by Thomas B. Salter, officer and director, leaving a holding of 3,585.

Eastern Air Lines, Inc. Disposition of 107 common shares by Thomas E. Creighton, officer and director, leaving a holding of 5,370; acquisition of 531 common shares by Maurice Lethbridge, officer, making a holding of 531; acquisition of 796 common shares by Frank Sharpe, officer, making a holding of 799; acquisition of 186 common shares by Edwin L. Williams, officer, making a holding of 213.

General Dynamics Corp. Acquisition of 2,880 common shares by Ellsworth C. Alvord, director, making a holding of 5,495, and disposition of 3,032 common shares leaving an indirect holding of 25,052; disposition of 600 common shares by Frederic de Hoffman, officer, leaving a holding of 3,730; disposition of 1,000 common shares by Vernon M. Welsh, officer, leaving a holding of 9,000.

General Precision Equipment. Disposition of 500 common shares by Joel Dean, director, leaving a holding of 1,600; disposition of 2,472 common shares by George T. Link, director, leaving a holding of 500; acquisition of 2,000 common shares by The Martin Co., beneficial owner, making a holding of 185,700; acquisition of 150 shares and disposition of 100 shares of $4.75 preferred, leaving an indirect holding of 50; acquisition of 264 shares of $2.98 convertible preferred by T. Roland Berner, director, making an indirect holding of 264.

Grumman Aircraft. Disposition of 2,240 common shares by L. R. Grumman, officer and director, leaving a holding of 133,160.

Litton Industries, Inc. Acquisition of 1,010 common shares by Roy L. Ash, officer and director, making an indirect holding of 12,997 (direct holdings remain 119,452); disposition of 8,000 common shares by Myles L. Mace, director, leaving a holding of 16,685; disposition of 600 common shares by Glen McDaniel, officer and director, leaving a holding of 19,900; acquisition of 800 common shares by Russell W. McFall, officer, making a holding of 825; disposition of 5,000 common shares by Joseph A. Thomas, director, leaving an indirect holding of 15,206 (direct holdings remain 15,312).

Lockheed Aircraft Corp. Acquisition of 1,200 capital shares through exercise of option by John E. Canaday, officer, making a holding of 1,300; acquisition 1,200 capital shares through exercise of option by Frank L. Frain, officer, making a holding of 2,230; acquisition of 3,600 capital shares through exercise of option by Courtlandt S. Gross, officer and director, making a holding of 28,582; acquisition of 300 capital shares through exercise of option by Robert E. Gross, officer, making a holding of 143,572; acquisition of 640 capital shares through exercise of option by M. Carl Haddon, officer, making a holding of 1,138; acquisition of 320 capital shares through exercise of option by Reginald R. Kearton, officer, making a holding of 320; acquisition of 320 capital shares through exercise of option by W. Gifford Myers, officer, making a holding of 1,384.

Marquardt Corp. Disposition of 20,000 capital shares by Clifford D. Cooper, officer, leaving a holding of 38,434; disposition of 400 capital shares by Laurance S. Rockefeller, stockholder, leaving a holding of 184,574; disposition of 100 capital shares by Don L. Walter, officer and director, leaving a holding of 2,381.

The Martin Co. Disposition of 115 capital shares by George M. Bunker, officer and director, leaving a holding of 73,741.

National Airlines, Inc. Disposition of 120 common shares by Edwin C. McDonald, director, leaving a holding of 601.

National Research Corp. Disposition of $100,000 of 5% convertible debentures by William A. Coolidge, officer and director, his total holding.

North American Aviation. Disposition of 500 capital shares by Joseph G. Beerer, officer, leaving a holding of 800; disposition of 2,600 capital shares by Charles J. Gallant, officer and director, leaving a holding of 500; disposition of 800 capital shares by S. K. Hoffman, officer, leaving a holding of 600; disposition of 300 capital shares by J. Stanley Smithson, officer and director, leaving a holding of 516.

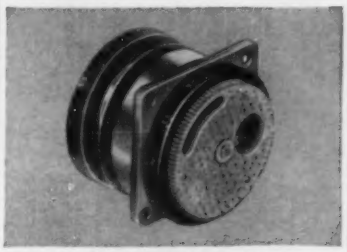
Northrop Corp. Disposition of 500 common shares by George F. Douglas, officer, his total holding; acquisition of 200 common shares through exercise of option by George Gore, officer, making a holding of 208; acquisition of 200 common shares through exercise of option by P. W. Timberlake, officer, making a holding of 200.

Northwest Airlines, Inc. Disposition of 800 common shares by Gordon M. Bain, officer, leaving a holding of 1,200; disposition of 1,900 common shares by Hadley Case, director, leaving an indirect holding of 18,100; acquisition of 700 common shares through exercise of option by Donald H. Hardesty, officer, making a holding of 710; acquisition of 500 common shares by C. L. Stewart, officer, making a holding of 500; disposition of 2,500 common shares by Albert J. Weatherhead, Jr., director, leaving a holding of 1,550; disposition of 200 shares of 5½% convertible preferred by Malcolm S. Mackay, director, his total holding.

ENGINEERING
REPORT
ON OTHER BENDIX
COMPONENT PACKAGES

CAM COMPENSATOR

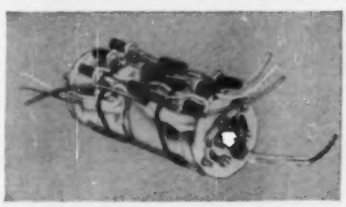
Efficient compensating device for servo system error.



The type CP-20-A1 is a simple, entirely mechanical means of correcting an output data shaft in relation to either servo loop errors, sensing errors, or known environmental factors affecting the system. Eliminates need for adjusting remotely placed or inaccessible units. Ask for full details.

CLUTCHED SYNCHRO

Transmits corrective signal, or establishes new reference.



The type CP-4-A1 is an integrated unit containing a high-precision pygmy Autosyn* synchro and an electro-magnetic clutch. Has general systemic application where it is desired to transmit a corrective signal, or to establish a new reference as a result of a temporary condition. Removal of electro-magnetic clutch excitation instantly re-establishes Autosyn, or signal source, at zero. Three unit-mounted resistors provide for proper output voltage as well as correct phase relationship of output voltage to excitation voltage. Write for further information.

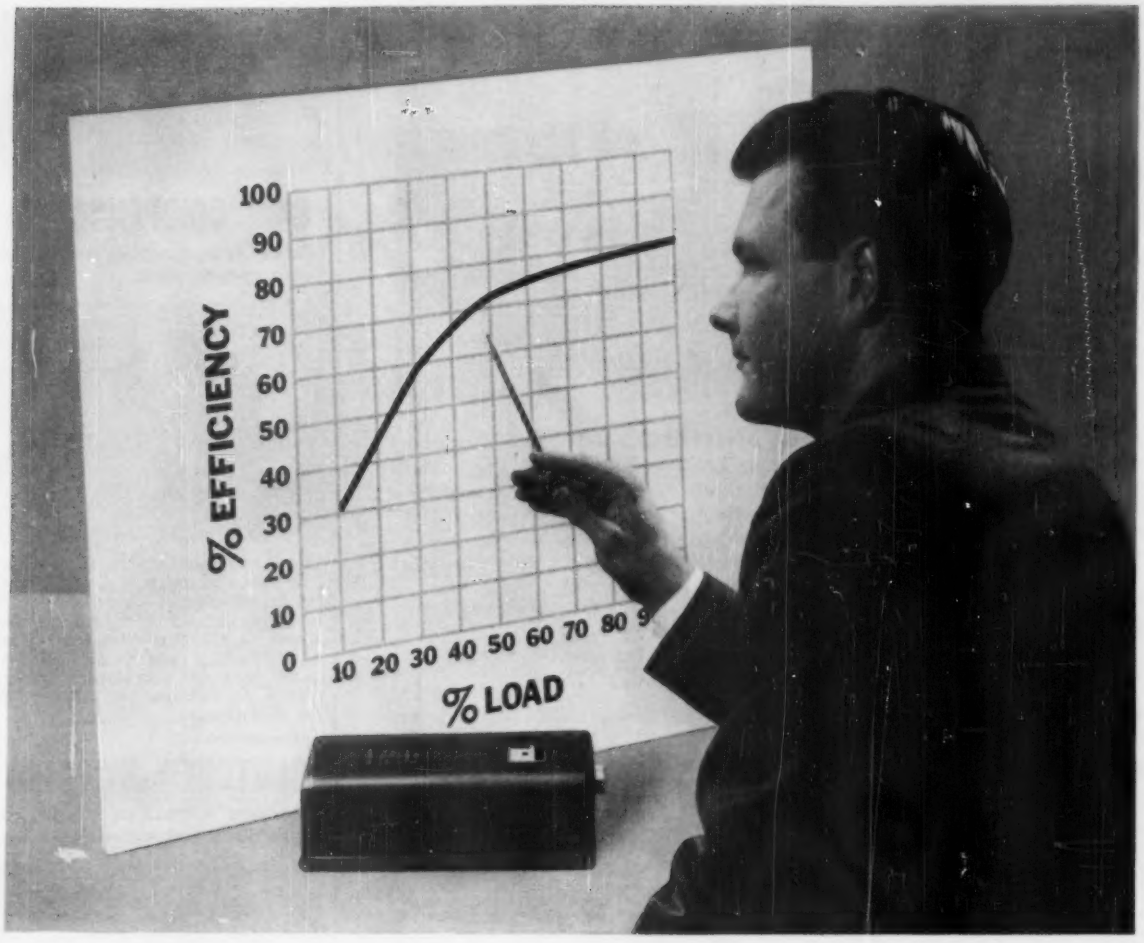
*REG. U. S. PAT. OFF.

Manufacturers of
GYROS • ROTATING COMPONENTS
RADAR DEVICES
PACKAGED COMPONENTS
INSTRUMENTATION

Eclipse-Pioneer Division

Bendix
AVIATION CORPORATION

Teterboro, N. J.



Over 70% efficiency at only half load with the Kinetics Static Inverter

Close frequency control and accurate phase displacement is obtained with crystal-controlled digital countdown circuitry.

The nearest approach yet to a flat efficiency curve for a static inverter is achieved by a new Kinetics design. Even at a fraction of full load, good efficiency is obtained. The Kinetics unit is ideal for aircraft and missile applications in the range from 15 VA to 15 KVA per phase.

There are no moving parts, no vacuum tubes and no transistors in high current circuits in the Kinetics inverter. The design features rugged silicon semi-conductor elements that are able to carry heavy current without failure. A common complaint about transistorized inverters is that they must incorporate cutoff devices in order to protect extremely sensitive power circuits from short circuits or high voltage transients. The silicon diodes will carry extremely heavy overloads, including shorts, for several seconds. This is usually long enough to trip the circuit breaker in the circuit carrying the short.

The Kinetics design offers low-loss regulation and the output is very nearly a perfect sine wave. A high degree of reliability is achieved by the use of extremely rugged components and the lack of complex circuitry. The Kinetics inverter is relatively unaffected by severe environmental conditions. Write or phone for more information. Kinetics Corporation, Dept K-22, 410 South Cedros Avenue, Solana Beach, Calif. SKyline 5-1181.

KINETICS
CORPORATION

ELECTRONICS · ELECTROMECHANICS

WHO'S WHERE

(*Continued from page 23*)

Changes

Edward O. Johnson, chief engineer, Semiconductor and Materials Division, Radio Corporation of America, Somerville, N. J. **Dr. D. Joseph Donahue** succeeds Mr. Johnson as manager-advanced development.

Dr. Kenneth W. Gardiner, chief research chemist, Consolidated Electrodynamics Corp., Pasadena, Calif., a subsidiary of Bell & Howell Co.

S. M. Stuhlbarg, corporate staff engineer in charge of the newly-organized Microminiaturization Development Program, P. R. Mallory & Co., Inc., Indianapolis, Ind.

Dr. Ernest A. Keller, associate director of engineering, Motorola's Chicago (Ill.) Military Electronics Center.

J. W. Keating, manager of the Solid Propellant Processing Division of Aerojet-General Corp.'s Solid Rocket Plant, Sacramento, Calif.

T. J. Josalle, general sales manager, Marman Division of Aeroquip Corp., Los Angeles, Calif.

Harold Maron, supervisor of sales-ground support equipment, REF Manufacturing Corp., Mineola, N. Y.

Seymour Weiner, product engineering department head, Sperry Semiconductor Division, Sperry Rand Corp., South Norwalk, Conn.

Frederick Van Sicklen, director-planning and controls, Continental Air Lines' Engineering and Maintenance Division.

Neil J. Waterman, assistant head-Atlas Project Office, Space Technology Laboratories' Flight Test Operations, Patrick AFB, Fla.

Col. Frederick A. Henry (USAF, ret.), manager of long-range planning, Summers Gyroscope Co., Santa Monica, Calif. Also: **Thomas N. Kasabali,** manager of military relations, Customer Relations Department; **Harry J. Schiele,** manager of the Dayton (Ohio) office.

A. L. Franzolino, director of technical training, American Airlines' Jet Maintenance and Engineering Center, Tulsa, Okla.

Frank W. Davis, technical consultant at Southwest Research Institute, San Antonio.

John Pink, products marketing manager, CompuDyne Corp., Hatboro, Pa.

Dr. Fred Moskowitz, assistant director of the newly-established Advanced Development Division, Laboratory for Electronics, Boston, Mass.

William Blandy, manager of manufacturing, Hitemp Wires, Inc., Westbury, N. Y.

Maxwell White, manager of the newly formed Advanced Systems Research Department of the Military Systems, Stavid Division, Lockheed Electronics Co., Plainfield, N. J. Also: **James N. Ottobre,** manager of the Development Laboratories on the staff of the director of Engineering, Stavid Division. **Richard H. Holmberg** succeeds Mr. Ottobre as manager of the Shipboard Electronics Department.

R. A. Irwin, director of space activities, Westinghouse Electric Corp., with headquarters in Washington, D. C.

Arthur J. L'Hommedieu, aircraft instrument sales manager, Weston Instruments Division of Daystrom, Inc., Newark, N. J.

Dr. Nicholas A. Begovich, assistant manager, Hughes Aircraft Co.'s Ground Systems Group, Fullerton, Calif. Also: **Dr. Arnold M. Small,** manager of the product effectiveness laboratory for the Ground Systems Group.

Robert P. Brush, assistant director of international commercial sales for Douglas Aircraft Co., Inc., Santa Monica, Calif.

Richard W. Couch, manager of the Systems Engineering and Management Operation, Sylvania Electronic Systems, a division of Sylvania Electric Products, Inc., Needham, Mass.

John H. Stickney, manager of Pacific Airmotive Corp.'s Burbank (Calif.) Aviation Products Branch.

B. A. Kvist, director of contracts, Aerojet-General Corp., Azusa, Calif.

Conrad Young, marketing manager, Communications and Weapons Division, Philco Corp.'s Government and Industrial Group, Philadelphia, Pa.

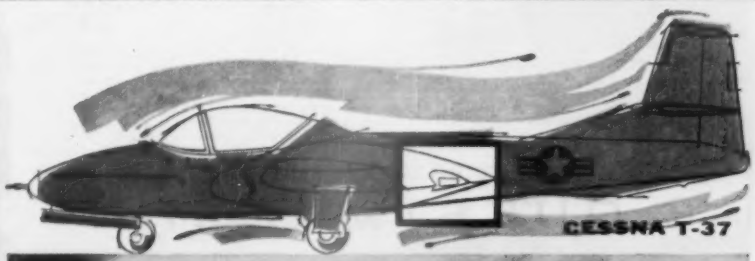
Earl H. Flath, Jr., senior scientist-radiation, antennas and microwave systems development, Temco Aircraft Corp.'s Electronics Division, Dallas, Tex.

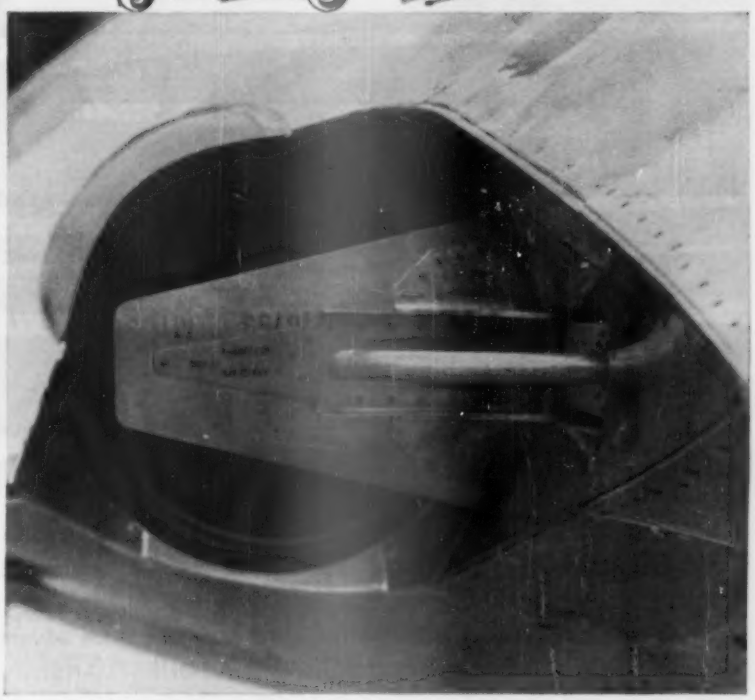
J. Kist has been named European representative for Parker Seal Co. with headquarters in Amsterdam, Holland.

Dr. Richard C. Potter, head of technical staff development, Ramo-Wooldridge Division of Thompson Ramo Wooldridge, Inc., Los Angeles, Calif.

Stanley M. Smolensky, executive director of marketing, Reaction Motors Division of Thiokol Chemical Corp., Denville, N. J.

John A. Moreno, executive assistant in charge of engineering administration, Marquardt Corp's Pomona (Calif.) Division.





INSTANT-THRUST PROBLEM—SOLVED BY CESSNA

Problem: How to provide, in a jet trainer, instant reserve thrust.

Solution: Cessna T-37's thrust attenuators. Extended, the attenuators deflect exhaust blast, cut effective thrust over 40%; increase landing glide-path control while engines continue at higher power. Should the occasion demand, student retracts attenuators, unleashes full reserve power *instantly*.

Thrust attenuators are one of many reasons why the low-cost T-37 is the Air Force's standard intermediate jet trainer—and one more of the ways Cessna "Problem-Solving" Research is ever at work to assure America's future in the air.

Military Division, Wichita, Kansas

CESSNA

AC Seeks and Solves the Significant—Because of GM's large contribution in the international race for technological superiority, AC accepts a challenge. AC Research is on a scientific quest for solutions to significant problems . . . for accomplishments even more advanced than AChiever inertial guidance for Titan. / We call this creative challenge . . . AC QUESTMANSHIP. It's an exciting quest for new ideas, components and systems . . . to advance AC's many projects in guidance, navigation, control and detection. / Right now Dr. Joseph F. Shea, AC's Director of Advanced Systems Research and Development, is drawing a group of competent men around him to build "the greatest R & D organization in the industry." And Dr. Shea adds strong support to the fact that AC offers "an excellent working atmosphere for a scientist or engineer who wishes to produce and progress." / You may qualify for our specially selected staff . . . if you have a B.S., M.S. or Ph.D. in the electronics, electrical or mechanical fields, plus related experience. If you are a "seeker and solver," write the Director of Scientific and Professional Employment, Mr. Robert Allen, Oak Creek Plant, 7929 So. Howell Ave., Milwaukee, Wisc.

GUIDANCE / NAVIGATION / CONTROL / DETECTION / AC Spark Plug THE ELECTRONICS DIVISION OF GENERAL MOTORS

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

DISPLAYED RATE:

The advertising rate is $31.00 per inch for all advertising appearing on other than on contract basis. Contract rates on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

UNDISPLAYED RATE:

$2.70 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

PROPOSALS, $2.70 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

Send NEW Ads or Inquiries to Classified Adv. Div. of Aviation Week, P. O. Box 12, N. Y. 36, N. Y.

FOR SALE

SPARE PARTS INVENTORY
LARGEST IN WORLD

DOUGLAS

DC3 - C47 - DC4 - C54 - DC6 - DC7

LOCKHEED-CONNIE

ALL MODELS

BEECHCRAFT

D18s - C45 - C18s

ALL MILITARY MODELS
PISTON & JET ENGINE

CHARLOTTE AIRCRAFT CORP.
P.O. Box 9127 Delta Air Base Charlotte, N. C.
TEL: KEystone 7-0212 CABLE: AIRCHAR

SEARCHLIGHT Equipment Locating Service

NO COST OR OBLIGATION

This service is aimed at helping you, the reader of "SEARCHLIGHT", to locate surplus new and used aviation equipment and components not currently advertised. (This service is for USER-BUYERS only).

How to use: Check the dealer ads to see if what you want is not currently advertised. If not, send us the specifications of the equipment wanted on the coupon below, or on your own company letterhead to:

Searchlight Equipment
Locating Service
c/o AVIATION WEEK
P. O. Box 12, N. Y. 36, N. Y.

Your requirements will be brought promptly to the attention of the equipment dealers advertising in this section. You will receive replies directly from them.

Searchlight Equipment Locating Service
c/o AVIATION WEEK
P. O. Box 12, N. Y. 36, N. Y.

Please help us locate the following equipment components.

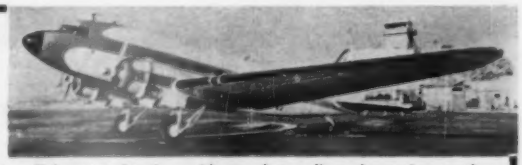
.....

.....

.....

NAME .....
TITLE .....
COMPANY .....
STREET .....
CITY 4/25/60

FIVE EXECUTIVE DC-3's



Take your choice! With 1830 Super 92's, 94's and 75's. Some completely equipped with Radar, A/P, JATO, I.F.S., D.M.E., R.M.I. Beautiful custom interiors with complete galleys, lavatories, couches for sleeping, bars, Janitrol heat, Airstair door, speed kits and many other extras. Low time. Will take trades, finance or lease. (Due to unprecedented acceptance of our Martin 404's we have a large selection of trade-ins—all priced to sell.)

CALIFORNIA AIRMOTIVE SALES CORP. Dept. A.W.
7139 Vineland Ave., No. Hollywood, Cal. TRiangle 7-1564
N.Y. Branch: 600 Fifth Ave., New York, N.Y. JUdson 6-4552
Airport Facilities: Hangars 2 & 27, Lockheed Air Terminal, Burbank, Calif.

ADDRESS BOX NO. REPLIES TO: Box No. Classified Adv. Div. of this publication. Send to office nearest you.
NEW YORK 36: P. O. Box 12
CHICAGO 11: 520 N. Michigan Ave
SAN FRANCISCO 4: 68 Post St.

FOR SALE

PBY 5A. Two amphibians converted for 2 crew—cargo—passenger use. FS-3404, Aviation Week.

Two S-55 Sikorsky Helicopters, complete except engines and instruments. $25,000 each. New and major overhauled spares available at 50% off list prices. Stinson Field Aircraft, Box 1738, San Antonio, Texas. CA 4-8434.

R-17 Engines as follows: one new 1820-97 at $1,000 and 7 NTSO at $750 each. Each engine sealed in steel container. Complete records. Stinson Field Aircraft, Box 1738, San Antonio, Texas. CA 4-8434.

Bell Helicopter 47G-2, Serial 2234 never damaged, clean. R.R. Stuart, Jr., Betsy Ross Bakeries, Inc., P.O. Box 1070, Bluefield, W. Va., phone: DA 7-6151.

1958 Bell Helicopter 47G2, fully equipped, ready to fly. TT620, 600 inspection done. Blades factory reconditioned. J-W Helicopters, Arcata, Airport, Calif. TE 9-2216.

FOR SALE

CONVAIR 340

MODIFIED TO 440

27 Psgr Executive Interior

2600 hrs total time

RCA RADAR—A-12 AUTO PILOT
ENG. ANALYZERS—RADIO ALTIMETER
DUAL COMM. & NAV. RADIO
RA-10DD RANGE REC. & LOOP

$650,000.00

For Information

TEXACO Inc., N.Y.C.
OX 7-8000
Purchasing: W. E. JONES
Technical: D. A. BALDWIN

SURPLUS
MOOG — HYD — SERVO VALVES
3000 PSI — $37.50 — GUARANTEED
JONCO COMPANY
11616 Allard St. Norwalk, Calif.
UN. 4-8613

D-18 BEECHCRAFT

Available Immediately, Excellent Condition
Asking $33,500.
OLIN MATHIESON CHEMICAL CORP.
Atlantic Aviation Atlas 8-9060
Teterboro Airport Teterboro, New Jersey

EXECUTIVE RETREAT, Northern Wisconsin

Luxurious Swiss chalet type lodge of massive whole log and stone construction (built 1938) situated in Vilas County, famous hunting, fishing and recreational area on a secluded point of land with 1,370 feet of shore line on one of the most picturesque (22 islands) lakes in America. Zoned for private estates only. Three bedrooms, 3 baths, 2 huge stone fireplaces, spacious studio living room, sunroom, kitchen, breakfast room, playroom and basement, with drive-in garage. Rustic guest cabin, tool house, boat docks and boat shelter. Custom furnishing and modern household equipment included in the sale price of $55,000 (flexible terms), one-half of replacement cost.

LAKELAND REALTY CO., Manitowish Waters, Wisconsin

DON'T FORGET

the box number when answering advertisements. It is the only way we can identify the advertiser to whom you are writing.

MUST SELL!

'59 Travel Air
2½ Sapphire—230 TT
Better Than New—Sacrifice
Phone Empire 3-2581
Granada Hills, California

EMPLOYMENT OPPORTUNITIES

NATIONAL COVERAGE

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant	Civil Service Opportunities	Employment Agencies
Positions Wanted	Selling Opportunities Wanted	Employment Services
Part Time Work	Selling Opportunities Offered	Labor Bureaus

DISPLAYED —RATES— **UNDISPLAYED**

The advertising rate is $52.00 per inch for all advertising appearing on other than a contract basis. Frequency rates quoted on request.

An Advertising Inch is measured ⅞" vertically on a column—3 columns—30 inches to a page.

Subject to Agency Commission.

$2.70 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.

Position Wanted Ads are ½ of above rate.

Box Numbers—counts as 1 line.

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Not subject to Agency Commission.

Send NEW ADS to Classified Advertising Div. of AVIATION WEEK, P. O. Box 12, N. Y. 36, N. Y.

ENGINEERING DEPARTMENT
MANAGER

INDUSTRIAL CONTROLS FOR NUCLEAR PRODUCTS

Unusual opportunity for the right man to direct the product engineering of industrial controls for nuclear products in a well-established company. Should be experienced and qualified to direct the total program of product application, design and development; production field and sales support. Knowledge of the present and future markets for products is required.

Advanced degrees or studies and being conversant in nuclear physics a requisite.

Located in a fine community in Western Michigan. Many social and cultural institutions provide an excellent atmosphere for family living.

Salary commensurate with experience and ability, comprehensive fringe benefits program.

Send resume of industrial experience and accomplishments to:

P4247 AVIATION WEEK

Class. Adv. Div. P. O. Box 12 New York 36, N. Y.

POSITIONS VACANT

Wanted Pilots: Vacancies for pilots/copilots with airlines and other organizations in Europe, North Africa, Middle East. Limited openings for Navigators/Engineers and A+P mechanics. Apply immediately to: American Overseas Aviation Services, Inc., 31 Weser Str., Frankfurt/M. Germany. Europe's Largest Flight Crew Employment Service.

British Engineering Company with Sales Office in Boston requires Executive to supervise sales in U. S. and Canada. Products include all types of gas turbine blades, aircraft and industrial gears and gearboxes and a wide range of precision machined components. Applicants should preferably have an Engineering Degree or equivalent and considerable experience of the operation of British Companies and of selling in the American market. Salary upwards of $15,000 per annum depending upon qualifications and experience. Applications should be addressed to the Managing Director, Centrax Limited, Newton Abbot, Devon, England.

Immediate opening for experienced co-pilot—mechanic with leading construction company. Applicants must have commercial license, instrument rating and A & P ratings. Prefer Beechcraft experience. Call or write Roscoe E. Harris, H. L. Coble Construction Company, P. O. Box 3328, Greensboro, North Carolina, Telephone BR 4-0137.

Aircraft Specialists—Openings available for well experienced Class "A" sheet metal specialists and Class "A" licensed airframe and powerplant mechanics. Top working conditions, good pay with usual benefits. Mattituck Airbase Corp., Linden Airport, Linden, New Jersey.

POSITIONS VACANT

Attention—Well known a/c company needs high quality personnel to start work immediately in the following positions: two (2) aircraft foremen; four (4) aircraft asst foremen; two (2) aircraft schedules. Men chosen must have previous experience with DC-6 and/or constellations. For interview send resume to P-4261, Aviation Week.

POSITIONS WANTED

Former Naval Aviator, Commercial, SEMEL, Instrument ratings. 4200 accident free hours. Extensive military flight & admin. experience. Current in modern jet and multiengine prop. aircraft as Naval Reserve instrument flight instructor. Presently employed. Interested in possibilities for future. Resume on request. PW-4102, Aviation Week.

Wind tunnel model designer with 8 years experience, B.S. of A.E. degree, desires position with small company, or will bid on your small jobs. C. W. Robertson, 1951 Manhattan Ave., Hermosa Beach, Calif.

Enthusiastic pilot with DC-3 type ATR, S&MEL&S, Rotocraft, Glider, CFI A&I ratings, desires light twin piloting position, CP heavy twin or what have you? Foreign or domestic. Military and American Flyers trained. Diversified background. Temperate, conscientious, dependable. Satisfaction guaranteed. Free trial period. Resume upon request. Ray Miller, McGregor, Iowa 625.

Mech. Engineer, living in Canada, 16 years experience in Aircraft and Engine, seeks a position with responsibility. Previous experience: inspection, research, maintenance, design, in supervisory and managing positions. PW-4263, Aviation Week.

ROCKET SYSTEM ENGINEER

The preliminary design department of The Marquardt Corporation's Propulsion Division offers an opportunity to an engineer capable of directing design and analysis of liquid and solid rocket propulsion as applied to advanced aerospace weapons systems. Must possess ability to keep abreast of rapid developments in rocket technology and integrate latest advances into appropriate application studies. Will also be responsible for technical promotional activities. MS in AE or Chemical Engineering desirable. Should have minimum of 8 years experience in liquid and/or solid rocket propulsion field including 2 to 3 years in preliminary design type of activity.

Write in Confidence to:
Floyd Hargiss, Manager
Professional Personnel
16555 Saticoy Street
Van Nuys, California

THE MARQUARDT CORPORATION

OFFICIAL PROPOSALS

Bids: June 21, 1960

Sale of (1) Beechcraft C45F

PUBLIC NOTICE IS HEREBY GIVEN that West Valley School District No. 363, Spokane County, State of Washington, by and through its Board of Directors will sell at public bid opening, to the highest bidder, at 8:00 pm PST on June 21, 1960 at the Administration Building of West Valley School District No. 363, one (1) Beechcraft C45F.

The aircraft is to be sold on an "as is" and "where is" basis and must be removed by the purchaser within thirty (30) days of the sale. Bids must be submitted for adaptation of the aircraft for commercial utilization. Modifications have been made to meet all CAA bulletins and both engines have a low number of hours.

For further information about the aircraft and a copy of the general sale terms & conditions, please write to West Valley School District No. 363, Millwood, Washington, or call WAlnut 4-2150.

• SALESMAN PILOT •

Required to demonstrate and sell twin engine executive aircraft. Must hold air line transport pilot's license and instrument rating. Send details of education, flying experience and photograph.

P-4258, Aviation Week
Class. Adv. Div., P. O. Box 12, N. Y. 36, N. Y.

Need Engineers?

Contact them through this

EMPLOYMENT OPPORTUNITIES section

WE NEED 2 GOOD MEN... AND WE NEED THEM SOON

- **Sales Engineer**
- **Sales Engineering Coordinator**

The rapid growth of our company, due to an exceptional increase in sales, and the addition of a new line of hydraulic motors and pumps, has created two opportunities for men who want to move ahead at an accelerated pace.

The sales engineer we are looking for has had experience with hydraulic motors and pumps: He is the kind of a man who likes the challenge of introducing, and selling, a new line of hydraulic motors and pumps with outstanding design features. He will also broaden his knowledge to include high pressure pneumatics.

The sales engineering coordinator we are looking for is presently employed in a similar position. This person is needed to perform a valuable function. We encourage, and expect, this person to extend himself to responsible phases of sales planning.

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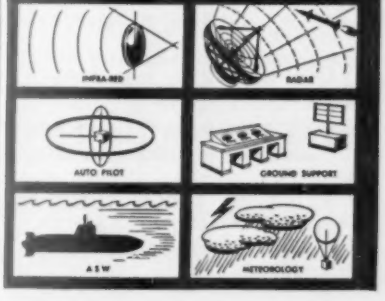

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You have written a letter to each of 63 different friends, and addressed the 63 corresponding letters. In how many ways can you make the regrettable mistake of putting every letter into a wrong envelope?

—*De Montmort, 1713*

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ANSWER TO LAST WEEK'S PROBLEM: Remember that a rocket leaving Earth on the 10th will meet at the launching pad the rocket which left Planet X on the 7th. The Planet X-bound rocket meets 17 Earth-bound rockets. The solution may be found graphically with ease.

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LETTERS

Aircraft Lights

In regard to the "see and be seen" policy now being emphasized by all users of the national air space, I believe that now is the time to get rid of the starboard and port navigation lights on all commercial and military aircraft and replace them with red "strobe" lights.

We are past the time when a pilot can waste valuable time "guesstimating" as to whether or not he has the "right of way."

The "all-red" lighting system would provide instantaneous recognition (for all pilots in the vicinity) of a potential hazard to navigation, and allow all concerned a bit more time to take evasive action.

In view of the fact that a red light is "red" as far as you can see it and that a high intensity green light will, at sufficient distance from its source, appear white, I believe the "all red" navigation light system would save a precious bit of time for evasive action.

JOHN P. MEAGHER
Lusby, Md.

Accident Cause

It is the official responsibility of the CAB to investigate accidents and to issue an official report of the probable cause after all the evidence has been carefully analyzed. Until such time it is improper for any interested party to publicly pronounce any theories. Nevertheless, several weeks ago, while the CAB investigators were still sifting the evidence, FAA Chief Quesada, whose agency is only one of the interested parties who play a subordinate role in accident investigation, offered his "explanation" of the recent crash of the Allegheny Airlines Martin 202 near Williamsport, Pa. Mr. Quesada said the crash was the result of "improper procedures" on the part of the pilot.

It is most interesting, therefore, to note (AW Apr. 4, p. 45) that a conflicting theory has been advanced by Mr. Oscar Bakke, formerly Chief of the CAB Bureau of Safety and currently Director of Flight Standards for Mr. Quesada's FAA.

According to AVIATION WEEK, Mr. Bakke told the House Appropriations Subcommittee that the Williamsport crash may have happened like this:

The copilot had a severe heart condition. (According to the heart specialist who testified at the CAB hearing, the heart condition had existed undetected and undetectable for a considerable period of time prior to the accident.)

Mr. Bakke said the copilot was still alive at the time of impact and that the autopsy apparently was not able to determine whether the copilot was having a heart attack at the time of the accident. With this heart condition, according to the Bakke theory, it is "quite possible" for the copilot to have been afflicted with a severe seizure which "might" have been sufficiently severe to immobilize him. This "possible" attack "could have" caused the copilot to "fall into the controls" diverting the pilot's attention. While this was taking place, the aircraft "could have" drifted off course toward a nearby mountain.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

At this point, AVIATION WEEK's quotation of Mr. Bakke shifts to a more positive tense, ". . . in a matter of 12 to 15 sec later, when he (the pilot) focused his attention upon the operation, it had become apparent to him that he was flying toward this high mountain. It was then too late for him to recover."

Sensational and fascinating as these conflicting theories of Mr. Quesada and Mr. Bakke may be, a third theory is much more plausible. The fact is, the aircraft involved in this accident had a peculiar instrument arrangement which placed both pilots at the mercy of the same single source of magnetic heading information—a type of electronic compass notorious for producing heading errors so subtle and insidious that the record is full of instances in which pilots trusting this instrument have suddenly found themselves flying off course on an erroneous heading.

There is at least one other instance in which a fatal airline accident can almost certainly be attributed to an erroneous heading indication by this very type of instrument.

In the Williamsport case, expert testimony clearly established that any one of a great number of different types of malfunction, to which this instrument system is subject, could have caused the type of erroneous heading indication which would have led the pilot to the mountainside. In fact, a test flight, using a sister ship, was able to duplicate the actual flight pattern while the pilot pursued such an indication, artificially produced.

The theory that the copilot may have diverted the pilot's attention by "falling into the controls" seems very far-fetched. As the aircraft was turning toward the runway heading, it entered an area of falling snow. Nevertheless, ground observers were able to note that no abrupt or erratic maneuvers were made. The aircraft simply made a normally-banked left turn away from the airport and toward the mountain. It was still flying straight and level when it disappeared from view.

It seems probable that the Allegheny pilot, following his heading indicator, was executing a perfectly proper missed approach procedure (insofar as he could determine from either his or his copilot's primary flight instruments) after losing sight of the airport because of snow clouds encountered during a perfectly proper circling approach.

This theory received a great deal of attention both during the investigation of the accident and during the official hearing conducted by the CAB. It is surprisingly strange that it has been so blithely ignored in the highly premature statements of both Mr. Quesada and Mr. Bakke.

Meanwhile, with attention focused on pilot failure, whether by head or by heart, little notice is given to the scandalous lack of approach facilities (no runway localizer, no glide path, no marker beacons, no homing beacons, no approach lights) at the Williamsport Airport.

J. L. DE CELLES
A Pilot
Kansas City, Mo.

MATS Workhorses

It is readily apparent that MATS has the "jet glamour fever" like all of the world's airlines (AW Mar. 21, p. 41, Mar. 28, p. 38). Their sole requirements seem to be the large super-jet cargo carrier. Just exactly who they are going to be able to serve with these non-versatile monsters is not exactly clear. The 70,000 lb., 3,500 mi., and the 40,000 lb., 5,500 mi. requirements indicate that MATS' only missions will be to carry bulldozers and Polaris missiles from San Francisco nonstop to Japan and/or Westover, Mass., to Paris.

Just how many fields are there in the world that can handle these monsters—particularly in the Middle East, Latin America, Africa and Asia which are the indicated areas of future world tension? There are not a half dozen airfields in these areas that have both runway lengths and load carrying requirements for these monsters. Perhaps my definition of "workhorse" is all wrong. If workhorse to MATS is a specialized vehicle to carry large volume and density cargos over limited and select routes to very limited locations, then I go along with their workhorse requirements. But if workhorse is to follow the classic definition of economy, versatility, and utilization for 90% of required missions, then MATS' jet monster is a far cry from a true workhorse.

Certainly MATS needs the big jets and the fast reaction capability, but is that all they need? It sounds like Eastern Air Lines making a complete conversion to 707-420s (Intercontinental). Granted that MATS' primary mission is logistics and not tactical or assault transport. However, logistics is not a simple problem of transporting millions of tons from Westover to Paris.

For versatility, over-all economy, and true workhorse application the turboprop is still incomparable. Studies by everybody from Rand to the Russians have verified this, but jet age snobbery seemingly blinds us to any other form of transportation except the pure jet. Over-all economy is not a matter of transporting 40,000 lb. 3,500 mi. at three cents a ton mile but also a matter of being able to move a mere 10,000 lb. 500 mi. at a reasonable cost; or not jeopardizing an entire operation with the loss of a single aircraft; and many other secondary factors.

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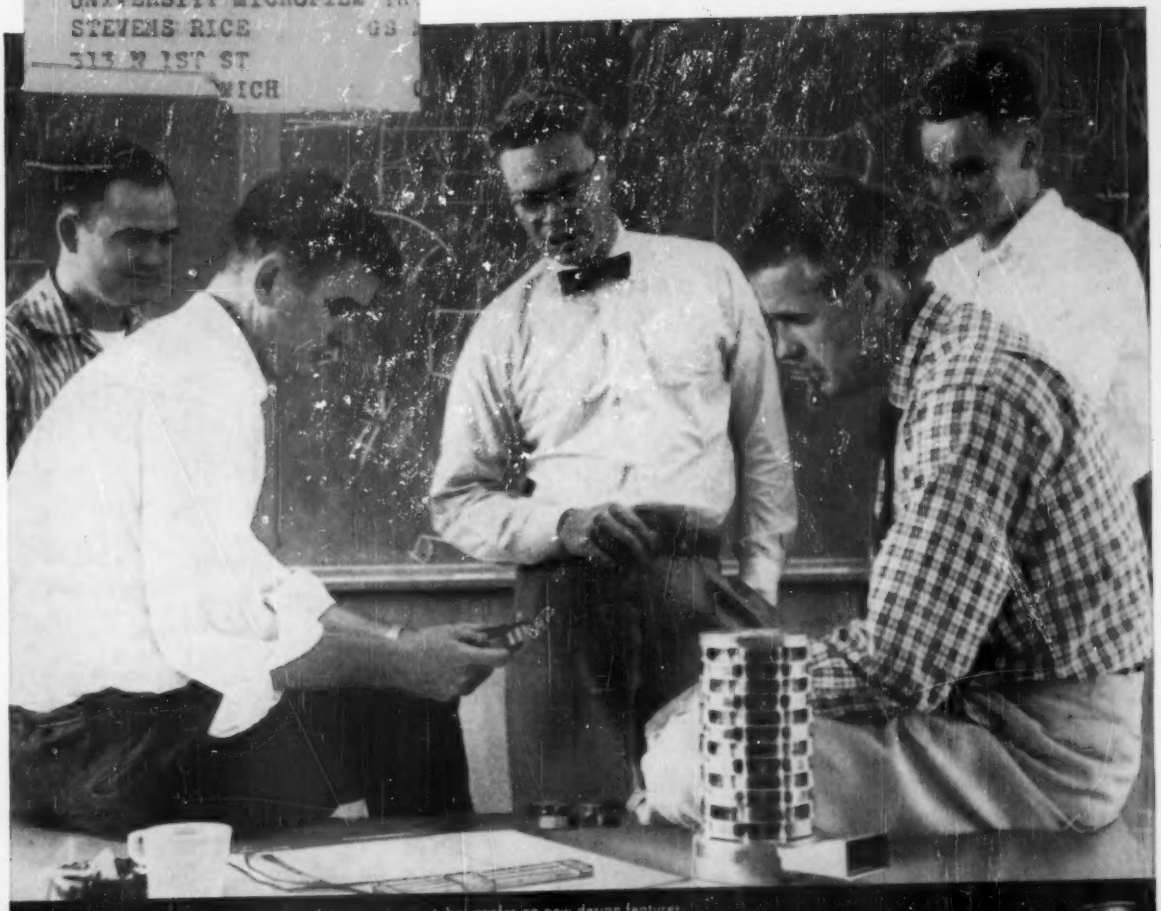

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